CURRENCY OPTIONS AND CENTRAL BANK OPERATIONS

Trading in currency options has become more active in global financial markets in recent years. Apart from concerns about the risk management of financial institutions engaging in option trading, there has been growing interest in central banks' use of currency options in central banking operations. The HKMA has conducted a study on the theory and practice of the use of currency options in monetary management. The EFAC Sub-committee on Currency Board Operations also considered the issue at its 5 November 1999 meeting. The conclusion is that there is no immediate need to consider the use of option trading strategies by the HKMA. The subject will, however, be kept under review in the light of changing market conditions.

I. Introduction

Financial derivatives facilitate the unbundling, repackaging and reallocation of risks. The leveraged nature of derivatives helps to lower the costs of trading and hedging, thus enhancing the liquidity of the underlying assets. The information content of derivatives is also highly valuable. For instance, a recent study suggested that the probability density implied by currency options pricing can be used to infer market expectations of movements in the underlying currency[1].

The financial leverage that can be generated by options transactions also has important implications for policy makers. At the risk of over-generalisation, central banks' concerns lie in three areas. First, at the market level, high leverage facilitates speculation at reduced cost, and may exacerbate market volatility. For example, the dynamic hedging behaviour of option writers, which we shall discuss in greater detail in the next section, can be destabilising and augment market swings. As a case in point, an IMF review of the events leading up to the exit of sterling from the Exchange Rate Mechanism in late 1992 estimated that "currency sales from dynamic hedging ranged from 5% to 10% of the overall selling volume stemming from the crisis".[2]

Second, at the institutional level, central banks have to ensure that banks have proper internal controls to prudently manage the risks associated with financial derivatives. Laxity in risk management has brought down established institutions, posing significant threats to systemic stability.

Third, there has been increasing discussion of whether central banks should proactively use derivatives for monetary management. A frequently cited example is the Mexican central bank's option selling programme to bolster its foreign reserves introduced in August 1996. Recently, the Reserve Bank of Australia (RBA) has also used currency options as part of its market operations to stabilise the exchange rate.

The present paper focuses on the third dimension of financial derivatives. In particular, we examine the analytical issue of whether or not the writing of options by the central bank could work to stabilise the foreign exchange market. We conclude that, analytically, there is a case that such activity would stabilise exchange markets. In particular, it would help crowd out the destabilising dynamic hedging behaviour that would otherwise be conducted by option writers in the face of changing market conditions. From the practical perspective of Hong Kong's markets, however, it is not clear that dynamic hedging has been an important source of instability in the Hong Kong dollar market. In addition, any benefits that would arise from the HKMA's use of options would need to be weighed against the costs of further complicating the

1 "Estimating and Interpreting Probability Density Functions - Proceedings of the Workshop held at the BIS on 14 June 1999", BIS, 1999.

2 *International Capital Markets*, Morris Goldstein, David Folkers-Landau and others, International Monetary Fund, 1993.

currency board arrangements, and the risk of creating a negative perception that the HKMA was engaging in new and risky activities.

The paper is organised as follows: Part II describes the growth of the derivatives market, and the currency options market in particular, both globally and in Hong Kong; Part III discusses the properties of options and the option-trading strategies of market participants; Part IV explores the literature on the use of currency options in monetary management. Some policy considerations in the context of Hong Kong are discussed in Part V, before concluding with an overall assessment.

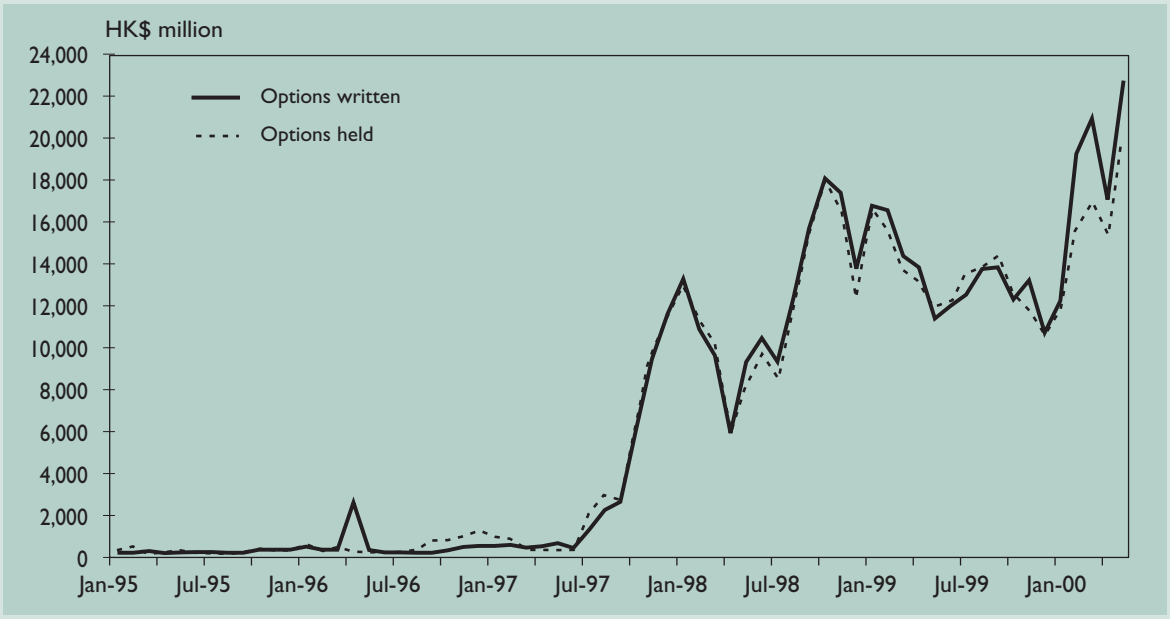
II. Market Size and Daily Turnover of Financial Derivatives

There has been a significant expansion in the derivatives market in recent years, in terms of both the types of products traded and transaction volumes. According to the 1998 Bank for International Settlements (BIS) global survey of foreign exchange and derivatives markets, the estimated daily turnover of over-the-counter (OTC) derivatives[3] amounted to US$1.27 trillion, an increase of almost 65% (in constant dollar terms)[4] over the figure in the 1995 survey[5]. In terms of the size of the outstanding contracts, the notional value amounted to US$72 trillion. The gross market value[6] was much smaller, however, at US$2.6 trillion, or 3.6% of the notional amount.

Survey results for Hong Kong show that the daily turnover of OTC foreign exchange options involving authorised institutions (AIs) and major securities houses in Hong Kong increased significantly to US$983 million (or by 57%) in the three-year period to April 1998. Looking only at currency options, HKMA data collected from AIs[7] indicate that the trading of Hong Kong dollar options was rather inactive prior to mid-1997

Chart 1

Authorised Institutions' Aggregate Positions in Hong Kong Dollar Options



Note: Positions refer to the sum of potential sales and purchases of options written or held

3 The survey covers OTC foreign exchange and interest rate instruments such as swaps, options and forward rate agreements, but excludes smaller market segments such as commodity, equity and credit-related contracts. Turnover was measured in terms of the nominal or notional amount of the contracts.

4 "In constant dollar terms" means that the turnover statistics of 1995 and 1998 are valued at April 1998 exchange rates.

5 Differences in market coverage, reporting date and reporting principle may prevent full comparability of the results obtained in the two surveys.

6 Gross market values are defined as the costs that would have been incurred if the contracts had been replaced at market prices prevailing at 30 June 1998.

7 Based on statistics collected from HKMA banking returns on the net and gross option positions of AIs. Option positions of the non-AIs, however, are not known.

(Chart 1), with a total notional size of contracts of less than HK$3 billion. However, amid the Asian financial turmoil, the demand for currency options for hedging and speculative purposes rose, and options written by authorised institutions surged to around HK$15-18 billion in late 1998.[8] This figure is likely to underestimate - perhaps significantly - the size of the Hong Kong dollar options market, as those written by non-AI financial institutions in Hong Kong and by offshore institutions have not been included because of a lack of data.

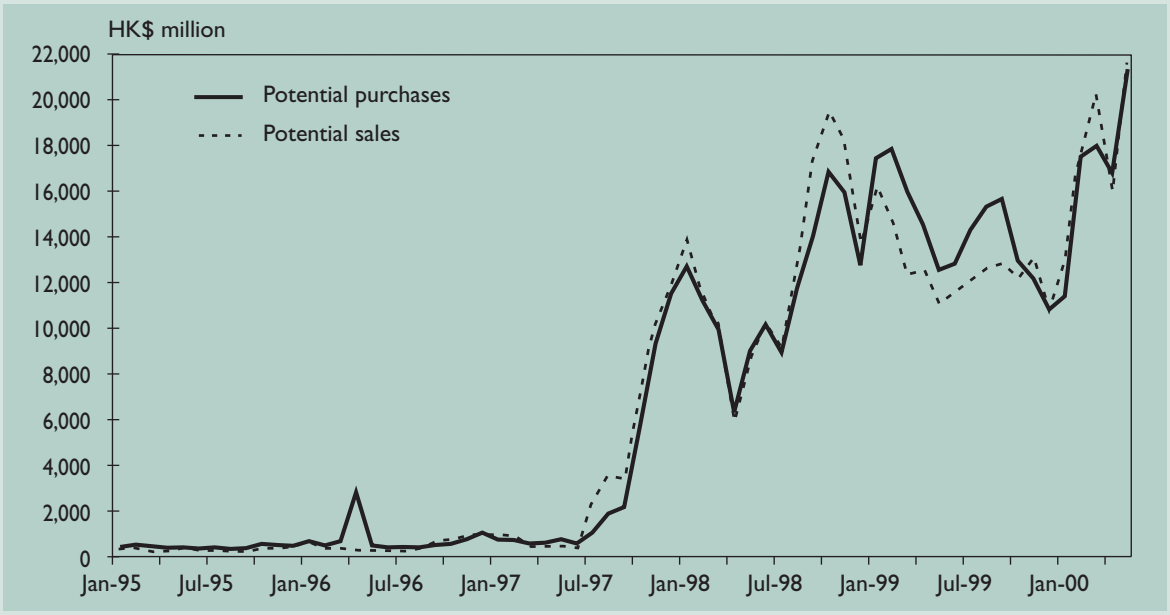
As for AIs in Hong Kong, they are mainly market makers quoting bid-ask spreads on currency options. As seen from Chart 1, while the outstanding amount of options written by AIs amounted to around HK$23 billion at end-May 2000, they had purchased a roughly equal amount of options to hedge their position. This raises the interesting question of who the ultimate suppliers of Hong Kong dollar options are. Anecdotal evidence from market sources suggests that some corporates in Hong Kong write "naked" put options on the Hong Kong dollar to enhance the yield on their US dollar cash reserves. Some overseas bank branches were also reported to have written Hong Kong dollar put options during the crisis.

In a typical transaction, then, a local bank might buy a Hong Kong dollar put option from a corporate customer and resell it in the market, taking no net exposure to currency risk. Alternatively, banks (or the corporates themselves) could cover the currency exposure incurred by writing options through "dynamic delta hedging". As discussed in greater detail below, this involves purchasing the underlying deliverable (US dollars in the case of a Hong Kong dollar put option) in an amount that reflects the probability that the option will be exercised and delivery will in fact occur. This type of hedging by options writers can be destabilising, as they will tend to purchase more of the deliverable (say US dollars) as the Hong Kong dollar weakens and the probability of a Hong Kong dollar put option being exercised increases. So market pressures are reinforced as option sellers try to dynamically hedge their positions.

Chart 2 presents a clearer picture of the AIs' currency exposure in the option market. Potential

Chart 2

Authorised Institutions' Aggregate Positions in Hong Kong Dollar Options



Note: Positions sales and purchases refer to the gross amount that the authorised institutions may be required to purchase or sell under options written, and the gross amount that the authorised institutions may purchase or sell through exercise of options held.

8 The total notional size of option contracts is crudely taken as the sum of total options written and purchased by AIs. There may be overestimation, as double counting arises out of transactions between AIs.

sales of Hong Kong dollars arising from option positions amounted to HK$22.1 billion at end-May 2000, slightly higher than potential purchases of HK$21.2 billion (Chart 2). In other words, AIs held a net short position in the Hong Kong dollar as a result of their option activity. The net position arising from option trading, however, has been small in relation to the AIs' overall foreign currency position (Chart 3).

III. Option Trading Strategies

Properties of Options

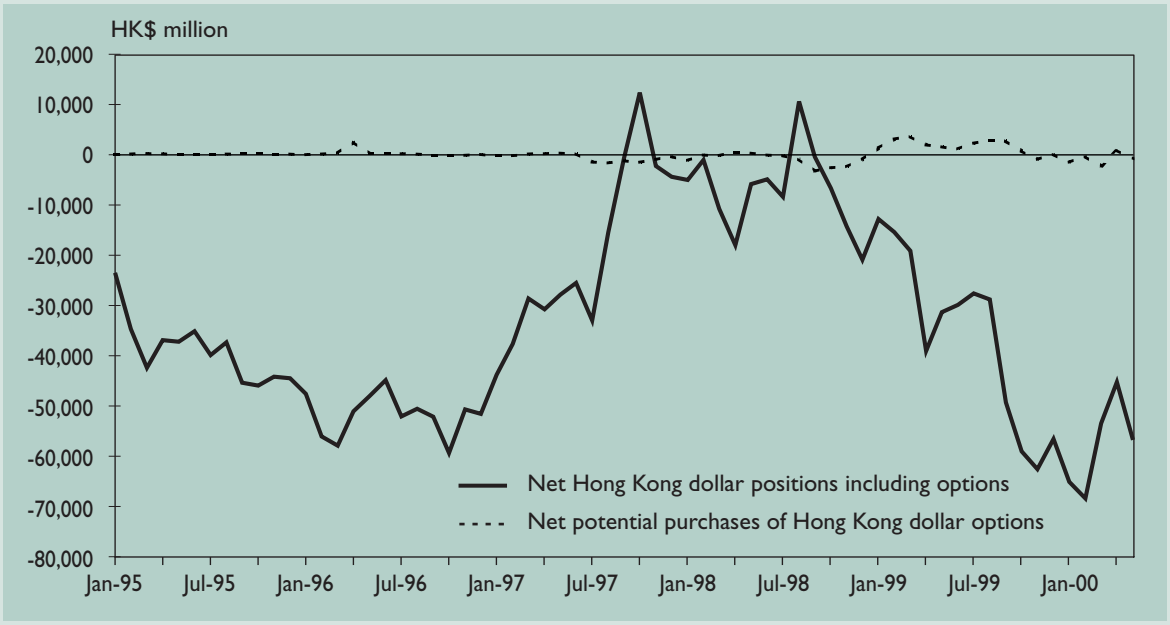
Forwards and options are instruments whose prices depend on the values of the underlying assets. A fundamental difference between the instruments lies in their payoff patterns. The payoff to a forward contract is linear in the market price of the underlying asset at expiry. This linearity means that forwards can, theoretically, be exactly replicated by spot transactions. As such, other than the differences in leverage, transparency, and market liquidity, the use of forwards by central banks will yield the same effects as spot market operations. Options, on the other hand, have a state-dependent non-linear payoff schedule that cannot be exactly replicated in spot markets. As a result, the market value of the positions that option buyers and sellers have in a currency depend, not only on the initial amount of options purchased or sold, but also on subsequent movements in market prices. This dynamic and endogenous response of currency positions to movements in market prices, in turn, implies interesting properties that warrant more in-depth study on the use of options in monetary management.

Broadly speaking, there are two types of options: calls and puts. The buyer of a call/put option has the right (but not the obligation) to buy/sell the underlying asset by a certain date for a certain price (called the strike or exercise price). Conversely, the seller (or writer) of a call/put option has the obligation (but not the right) to sell/buy the underlying asset when the option is exercised by the holder. The buyer of the option is said to have a long position in options, while the seller has a short position. Over-the-counter (OTC) traded options with customised transaction sizes, strike price and other parameters, are more heavily traded than exchange-traded options.

Similar to forwards, options first emerged to provide a hedging tool for investors against price

Chart 3

Authorised Institutions' Aggregate Positions in Hong Kong Dollar (including options)



fluctuations of the underlying asset. However, as both counterparties to a forward contract are obliged to exercise the contract, while those to an option contract have asymmetric obligations, the payoff patterns are different (see Figure 1). The linear payoff to a forward is illustrated in Figures 1(a) and 1(b). A long position generates profits (losses) should the future price rise above (fall below) the contract price. The contrary is true for a short position. A long position in options, however, gives the buyer unlimited upside gain should the price move favourably, while the maximum loss is capped by the option premium (Figures 1(c) and 1(d)). This asymmetry in the payoff stems from the right (not obligation) conferred to the buyer to exercise the option, which he will do only when market conditions are favourable. Should market conditions be unfavourable, the option will not be exercised and the loss will be confined to the premium paid to the option seller. The payoff to a short position is merely the mirror image of the long position, implying unlimited downside risk, but with the maximum gain limited to the option premium (Figures 1(e) and 1(f)). This asymmetry implies a transfer of risk from the option buyer to the seller - compared with a forward contract, the buyer of an option faces less risk while the seller faces greater risk.

Hedging of Option Position

To hedge against the unlimited downside risk associated with a short position in options, the simplest hedge for an option seller is to purchase an exactly offsetting contract. For example, to hedge against the exposure of a short call position, the seller can buy a call option with the same terms (see Figure 1(g)), or buy a put option and the underlying asset (spot or forward) at the same time (see Figure 1(h)). The payoff of the latter combination will replicate that of a long call position.

Alternatively, the option seller may hedge its exposure less directly by purchasing futures contracts in the underlying asset. To maintain a neutral position in the underlying asset, a call option seller, in anticipation of its obligation to sell the underlying asset on the option expiry date, may hedge by initially holding a long position in the asset. Neutrality, however, does not imply holding assets equal to the total face value of the contract. In particular, to balance the seller's position, the proportion of the underlying asset held should reflect the probability of the call option being exercised on expiry when the asset has to be delivered to the buyer. This probability is indicated by "delta". In the event, delta can be measured by the change in the option price in response to a change in the price of the underlying asset. For example, an at-the-money call option (the strike price being the same as the forward price) has an initial delta very close to 0.5, meaning that there is a nearly 50% chance that the future price will rise above the strike price and thus the option will be exercised.[9] To hedge, the option writer will take a long position in the underlying asset equal to 50% of the notional size of the option to maintain a delta-neutral position. As delta changes over the life of the option in response to changes in market prices, the writer would rebalance his portfolio by increasing (decreasing) the amount of the underlying asset held as delta rises (falls). This is so-called "dynamic hedging".

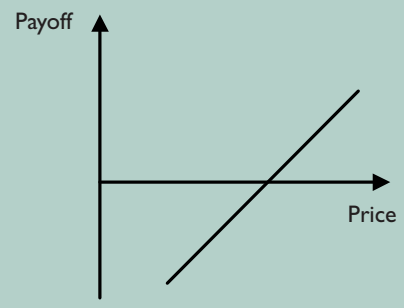
Market participants with different option positions will respond differently to the same price movement in the underlying asset. Consider the case when the forward value of the Hong Kong dollar weakens. As the probability that a Hong Kong dollar put option will be exercised increases, the option writer would sell Hong Kong dollars in the spot or forward market to remain delta-neutral.[10] This would reinforce the initial price movement and exacerbate market volatility. To retain a neutral position, buyers of the option should buy Hong Kong dollars, thus offsetting the destabilising behaviour of option writers. Conventionally, however, it is assumed that option buyers (as opposed to sellers) do not dynamically hedge their positions in this way, either because

9 This assumes that the expected distribution of price movements is symmetric - a common assumption in options pricing. It may, however, be unrealistic in the context of fixed exchange rate regimes.

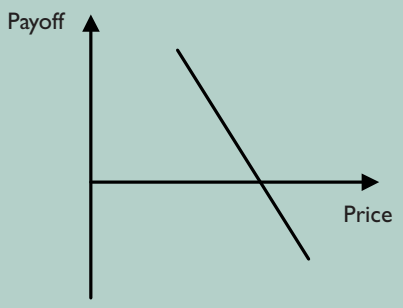
10 An illustrative example of the destabilising delta hedging of option writers is contained in Annex 1.

Figure 1

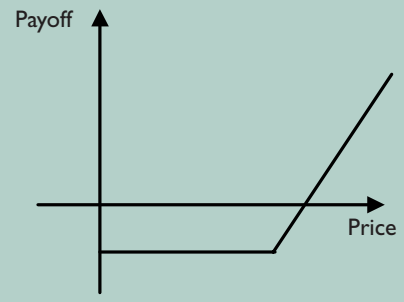
Payoff of Forward and Options



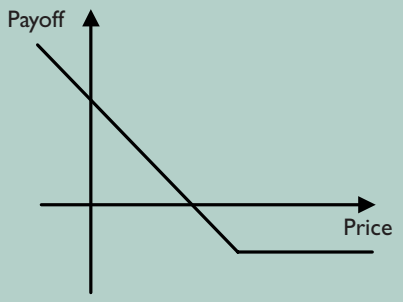
1(a): long position in forward



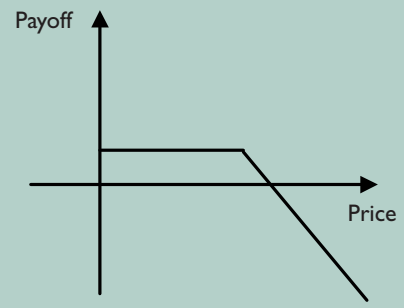
1(b): short position in forward



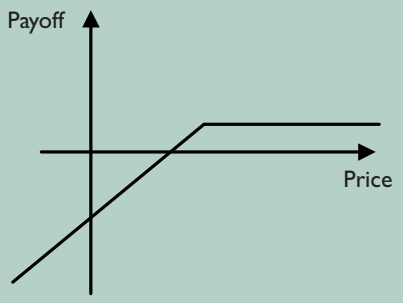
1(c): long call



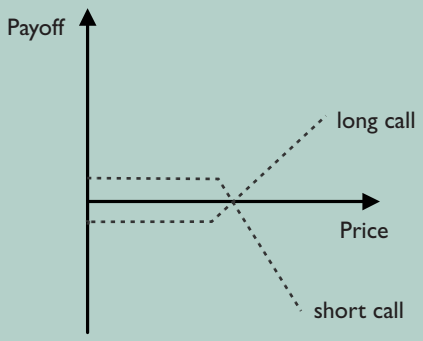
1(d): long put



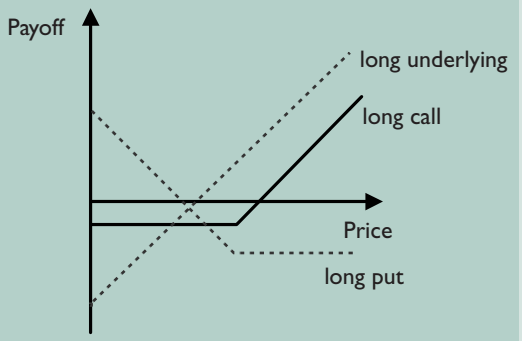
1(e): short call



1(f): short put



1(g): Hedging market risk of option by offsetting contracts



1(h): Replication of a long call option by a long put and long underlying position

they have bought the option to hedge an initial exposure, or because they wish to take a less risky "naked" position in the underlying asset. To the extent that dynamic hedging is concentrated among option sellers, the net impact on markets will be destabilising. As we shall see below, these properties have important implications for the central bank's decision to participate in the option market.

Dynamic hedging is expensive for option writers, as it implies "buying dear and selling cheap" as market prices fluctuate. However, if the ex-post volatility in the price of the underlying asset is less than that priced into the option premium, the seller who dynamically hedges will make money, as the costs of hedging will be less than the option premium he earns. In this sense, dynamic hedgers are taking a position on the volatility of the market price, not the direction of its actual movement. Alternatively, speculative option sellers who are willing to also bet on the direction of price movements may take open positions and leave them unhedged, similar to the strategy that might be adopted with a forward contract.

Pricing of Options

Standard pricing models for currency options are mainly derived from the famous Black-Scholes equation[11]. An important parameter in the equation is the implied market volatility. It is generally assumed that historical volatility, measured in terms of the standard deviation of market prices, is a reasonable estimate for the implied future volatility. Under the fixed exchange rate system of Hong Kong, however, the historical volatility of the Hong Kong dollar has been less than 1%[12]. The exchange rate expectation reflected in the forward premium on the Hong Kong dollar rose to over 7,000 pips during the Asian financial crisis, however, suggesting that future volatility far exceeds its historical average. The unbalanced expectation of a depreciation in the Hong Kong dollar in the past also suggests that the expected probability distribution is not symmetrically distributed. This renders the conventional option pricing model less applicable to the Hong Kong dollar - or, more generally for any fixed-rate currency regime that is not viewed by markets as being fully credible.

The pricing of currency options in fixed exchange rate regimes is more subjective, depending on the perceived probability of the currency being devalued or revalued. Consider a simple case where the only risk is one of devaluation, say a 10% probability of a 20% devaluation. Then the (risk-neutral) forward discount would be 2%. The "fair" premium on an at-the-money option would be somewhat less, say 1.8%, as the premium will be lost with certainty regardless of whether the currency devalues.[13]

In practice, the various scenarios will be more complicated than this, and would include the risk that the currency could also be revalued, which would tend to raise the premium on the option relative to the forward discount. Furthermore, agents do not behave as though they are risk neutral. Options trading involves the shifting of risk from buyers to sellers. In exchange for the assumption of this risk, sellers will generally charge a premium beyond that implied by the risk-neutral calculations.

Our discussions with market practitioners suggest that there is no standardised way of pricing options with reference to volatility formulae or risk premia. Rather, conventional practice is to price Hong Kong dollar options with reference to the forward premium. A rule of thumb for pricing Hong Kong dollar options is for the present value of the forward discount to form the floor of the option premium, suggesting that there is a perceived risk of currency appreciation.[14] The actual spread above the floor, however, is generally determined

11 A famous and commonly used model for pricing currency options is the one developed by Garman and Kohlagen (1983).

12 This is the standard deviation of the closing Hong Kong dollar exchange rate using data during January 1990 - October 1999.

13 If the currency does not devalue (90% probability), the options buyer will lose the premium of 1.8%. If the currency devalues (10% probability), the buyer will have a net gain of 16.2% (18% on the currency movement relative to the forward price less the premium of 1.8%). The probability-adjusted value of the payoff is then zero. In a competitive market, then, the premium would be 1.8% *if* all agents were risk-neutral.

14 Alternatively, the relatively expensive pricing of options could indicate that risk-neutrality is not a useful benchmark, and that options sellers are able to charge a significant premium for the risk transference properties of options versus forwards.

with reference to prevailing market conditions, including the subjective judgement of sellers as to the value of the options. Chart 4 below shows the movements of the forward premium on the Hong Kong dollar and at-the-money forward currency options from mid-1997 to mid-2000.

IV. Theory and Practice of the Use of Currency Options in Monetary Management

Literature on the use of currency options by central banks in defending a fixed exchange rate regime or for other monetary management purposes has been rising alongside the growth of option markets. A brief review of this literature provides the basis for a theoretical discussion of the advantages and disadvantages of option trading by central banks.

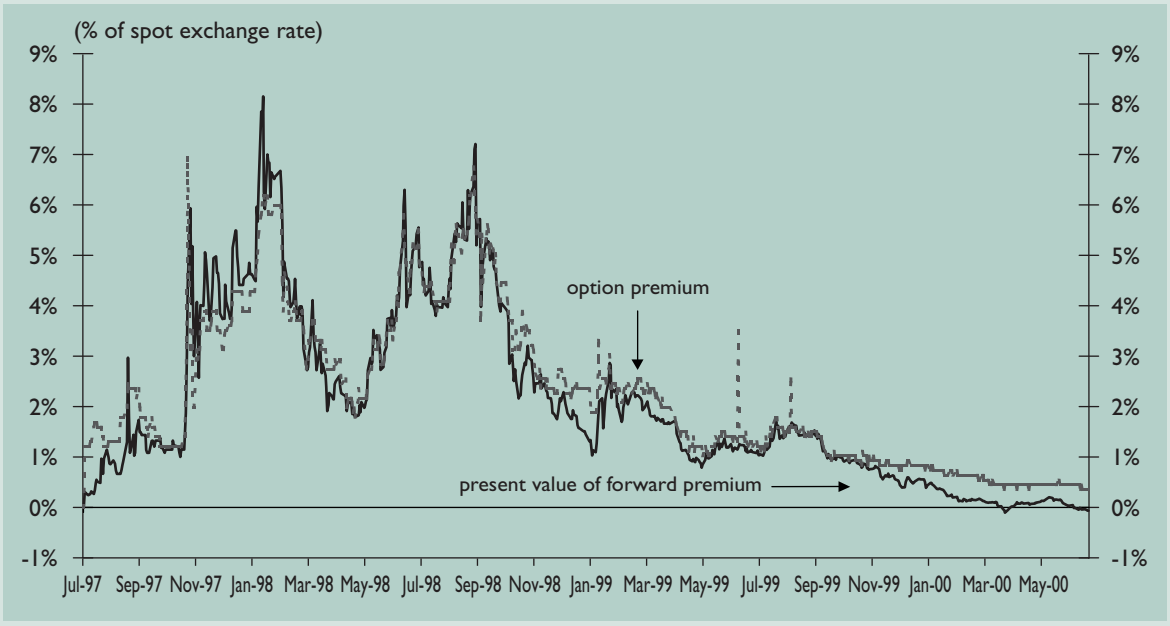
Taylor (1995)[15] suggested that a central bank might consider buying put options on its own currency. By doing so, it could acquire foreign reserves at less cost if the domestic currency were to depreciate significantly. These reserves could then be sold in the spot market to defend the domestic currency. This tactic is particularly appealing to a central bank that does not initially possess sufficient foreign reserves to defend its currency. Moreover, the financial commitment of the central bank would be relatively small and confined to the option premium.

Nevertheless, such a strategy may entail two major side effects: the adverse signalling effect; and the promotion of destabilising dynamic hedging behaviour among option sellers. That the central bank is buying put options on domestic currency may be perceived as a loss of resolve of the central bank to defend the existing exchange rate, signalling a planned depreciation of the currency. The adverse signalling effect will, in turn, affect investors' expectations, encouraging self-fulfilling behaviour and exerting downward pressure on the currency. Furthermore, as option sellers strive to maintain a delta-neutral position, they will sell the domestic currency when the risk of depreciation is perceived to increase, nullifying the intervention efforts of the central bank.

Chart 4

Hong Kong Dollar/US Dollar Forward Premium and Option Premium (1-yr, bid price)

(3 July 1997 - 30 June 2000)



15 *Options and Currency Intervention,* Charles R. Taylor, 1995.

The RBA has in recent years bought currency options as part of its monetary operations. However, instead of targeting at foreign reserves accumulation, currency options have been purchased by the RBA to defend the currency. In the midst of the Russian rouble crisis in August 1998, the Australian dollar suffered from heavy selling and dropped to a record low against US dollar at around 0.55. In order to stabilise the currency, the RBA bought Australian dollar call options. According to the RBA, its buying of call options helped stabilise the Australian dollar, as sellers of the options had to cover their short positions in the Australian dollar. Through intervening in the options market, the RBA remarked that it succeeded in stimulating significant demand for the Australian dollar with limited outlays[16].

Based on dynamic-hedging behaviour, Breuer (1999)[17] suggested that central banks might want to sell, rather than buy, options. To the extent that option buyers subsequently delta hedge their positions by buying domestic currency when it is depreciating, and sell when it is appreciating, their behaviour will help stabilise the exchange rate (as discussed above).[18] Moreover, the central bank, by writing options, will "crowd out" potential sellers of options, and the associated destabilising delta hedging that they might engage in. From a revenue viewpoint, the option premium provides an additional source of income to the central bank, increasing the return on reserves.[19]

Breuer's suggestion builds in a mechanism whereby exchange rate stabilisation is achieved through the automatic reaction of market participants, instead of discretionary intervention by the central bank. Note that this stabilisation will occur even if the amount of options sold is held constant over time - there is no need to vary the amount of options sold in response to market pressures, as there would be if stabilising intervention was conducted in the spot or forward markets. This feature reflects the nonlinear response of the option value to changes in market prices. In essence, as the forward discount on the domestic currency increases, the value of the put option (i.e. its delta) will also rise. In this sense, the central bank will have an increasing long position in domestic currency as market pressures increase, while the option buyers will have the offsetting short position resulting from the put options bought. This, then, is equivalent in a balance-sheet sense to direct intervention in the spot or forward market.

This automatic mechanism may be particularly attractive in a nondiscretionary system such as a currency board, because it does not involve discretionary decisions on how much intervention to conduct under different circumstances. However, the stabilising effect on the exchange rate will be reduced if market participants tend not to delta hedge. Option buyers may not delta hedge to the extent that they are already hedging another exposure, or because they want to take an outright position that is less risky than forwards. Similarly, sellers may not delta hedge to the extent that they are willing to assume risk and also want to take an outright position. Information on the extent of delta hedging in the Hong Kong dollar market is difficult to come by. Nevertheless, the fact that the banks tend not to take open positions in options suggests that one potential group of delta-hedgers is not likely to be active.

The effectiveness of the scheme also depends on whether its size is enough to make a significant difference to market dynamics. From the central bank's perspective, there is less constraint on the programme size when it writes call options on the domestic currency, as most central banks have the ability to create domestic currency in case the options are exercised. However, in writing put options, sufficient reserves have to be set aside to cover the contingent liabilities to make the scheme credible.

16 Reserve Bank Report and Financial Statements, 1999.

17 *Central Bank Participation in Currency Options Markets*, Peter Breuer, 1999.

18 Although, as has been argued earlier, dynamic hedging on the part of buyers is less likely than by sellers.

19 It should be noted that this premium is related to, but is conceptually distinct from, the additional income that could be earned by outright switching of excess reserves into domestic currency when there is a forward discount on the currency. Selling options, in contrast, will yield income even if there is no forward discount.

In practice, the Banco de Mexico is the only central bank known to be directly engaged in option writing. The bank started a peso call/US dollar put option programme in 1996 (see Annex 1 for details). Every month, the bank writes put options on US dollars with the obligation to buy US$200-250 million from the option buyers. However, instead of stabilising the exchange rate through option selling, as suggested by Breuer, the primary objective is for the bank to acquire foreign reserves without directly intervening in the market. By specifying a floating instead of a fixed strike price, the option is structured in a way that enables the bank to acquire foreign reserves without signalling to the market specific intervention levels. According to officials of the central bank, they were able to purchase around US$10 billion from the market in the last three years. Given the small size of these contracts relative to the daily turnover of US dollar transactions, amounting to US$10-12 billion, this options selling programme has had little impact on the exchange rate.

V. Policy Considerations in the Context of Hong Kong's Currency Board System

To recapitulate, there are four basic option trading strategies that central banks may consider: (i) buy put options on the domestic currency; (ii) write call options on the domestic currency; (iii) buy call options on the domestic currency; and (iv) write put options on the domestic currency. Having regard to prevailing market circumstances, the first two approaches do not look attractive. In the case of Hong Kong where our foreign currency assets stands at over US$90 billion, there is no pressing need for us to rely on the first approach to accumulate foreign reserves. More importantly, the possible adverse signalling effect and the destabilising dynamic hedging behaviour of option sellers under this approach would amplify pressures on the exchange rate. The second approach, namely the writing of Hong Kong dollar call options by the HKMA, should be technically feasible, but the market appetite is very uncertain, as concerns tend to be rather unbalanced towards the risk of Hong Kong dollar depreciation at times of market pressure.[20] It would also tend to add to pressures on the exchange rate in the first instance.

The remaining two approaches appear to hold out some benefits. Under the third approach, where the HKMA buys Hong Kong dollar call options in the market, this would give immediate support to the Hong Kong dollar since the sellers are likely to buy Hong Kong dollars in the forward market to delta hedge their positions. This will give one-off support to the exchange rate, similar to a forward purchase of Hong Kong dollars by the HKMA. The only difference is that, in the unlikely event of a depreciation of the Hong Kong dollar, the maximum loss incurred from holding options is capped by the cost of the premium, whereas the potential downside risk from a forward contract can be unlimited. Nevertheless, similar to forward market intervention, such activity may suppress early warning signals of rising forward points when there are speculative attacks on the Hong Kong dollar. Moreover, dynamic hedging conducted by the option sellers would aggravate any subsequent pressures on the exchange rate.

The most pertinent issue is whether the HKMA should sell Hong Kong dollar put options (i.e. the fourth approach). We assess below the feasibility and the desirability of a conventional options-writing scheme in the context of Hong Kong's currency board arrangements.

Design and Feasibility of a Hypothetical Scheme

The design of a hypothetical scheme should take into account the following aspects:

(a) Size

While we would not envisage that options written by the HKMA would be included in the monetary base, sufficient foreign reserves should be set aside to cover the contingent liabilities arising from the options position for the scheme to be credible.[21] As such, the size of the programme would be constrained by the free reserves of the Exchange Fund.

20 Anecdotal evidence in markets suggests that there has at times been strong demand for deep out-of-money call options on Hong Kong dollars, especially from traders who are bound by internal risk controls to hedge their short Hong Kong dollar position.

21 Under standard accounting principles, option positions are off-balance sheet items and only changes in gross market values of contracts are recorded in the accounts. The notional amounts need only be disclosed as memorandum items.

(b) Pricing

For the programme to signal a clear commitment to the system, the strike price would need to be set at 7.80 or slightly above 7.80. The price of the options should preferably be determined by the market through open tender or auctions.

(c) Probability of exercising the option

The weakening of the Hong Kong dollar exchange rate is capped by the Convertibility Undertaking rate at 7.80. Therefore, the put options would never be exercised unless the Convertibility Undertaking were to be abandoned. In the unlikely event that the spot Hong Kong dollar exchange rate, for whatever reason, weakened temporarily to below 7.80 on the expiry date of the options, there may be concern as to whether the exercise of the option would reinforce downward pressures on the Hong Kong dollar. It is, however, worth noting that, if the option transactions are settled through the Aggregate Balance, the interest rate adjustment mechanism would kick in, similar to the triggering of the Convertibility Undertaking. Specifically, the exercise of the put options would involve the holders selling Hong Kong dollar to the HKMA in return for US dollar at the rate of Hong Kong dollar 7.80. The corresponding contraction in the monetary base and the ensuing interest rate hike would help forestall further downward pressure on the Hong Kong dollar.

While such a scheme appears technically feasible, we would need to carefully weigh its pros and cons.

Potential gains that can be derived from an option writing programme include:

(a) Since options are legally enforceable contracts, such a scheme demonstrates a strong and clear commitment towards the maintenance of the linked exchange rate at 7.80. Improved confidence might in turn be translated into a reduced risk premium on the Hong Kong dollar, leading to lower Hong Kong dollar interest rates at times of market pressure.

(b) Option writing by the HKMA would crowd out destabilising dynamic hedging behaviour which might otherwise be conducted by option writers in the private sector.

(c) The programme could stimulate stabilising dynamic hedging behaviour of option buyers, to the extent that they maintain a delta-neutral position.

(d) The Exchange Fund could earn a premium from writing the options.

However, the option writing scheme would also entail certain risks and uncertainties:

(a) Currency options may provide an additional avenue for speculators to attack the Hong Kong dollar. While it may be argued that speculators would prefer forwards to options (if they do not see the need to cap the risk arising from Hong Kong dollar appreciation and are risk neutral), it is nevertheless worth noting that transactions in the forward market are subject to counterparty credit limits, while the purchase of a Hong Kong dollar option is not, and hence the leverage ratio can be considerably higher. Risk-averse speculators may also want to limit the potential losses from any Hong Kong dollar appreciation.

(b) The put option programme, once implemented, would be difficult to reverse, as any attempt to reduce the size of the programme might be perceived negatively as a loss of government resolve to defend the linked exchange rate.

(c) It is unlikely that a small issue size will generate a sufficiently large positive psychological effect to bring down the interest premium on the Hong Kong dollar. Psychology may also work in the reverse direction, if the ability of the monetary authority to honour too large an option obligation is questioned.

(d) While the currency board system has been functioning smoothly, the writing of option by the HKMA might complicate the system and arouse negative perceptions that the HKMA was engaging in risky activities or lacked the means to support the currency board system in the spot market.

Overall Assessment

The above discussion suggests that the offer of Hong Kong dollar put options by the HKMA would be technically feasible and would possibly yield some benefits under certain conditions. Nevertheless, there are also considerable uncertainties and risks. There is no objective framework for assessing the psychological impact or the optimal size of put options to be issued.

As part of the ongoing review of the currency board operation in Hong Kong, in late 1999 the Exchange Fund Advisory Committee's Sub-Committee on Currency Board Operations discussed the feasibility and desirability of the use of currency options in maintaining exchange rate stability under the currency board arrangements in Hong Kong. The Sub-committee concluded that the theoretical benefits that might be offered by currency options were, under current circumstances, outweighed by the disadvantages that they could bring. While the writing of options by the HKMA is not under current consideration, the subject will be kept under review in the light of changing market conditions.

- Prepared by the Market Research Division

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BANCO DE MEXICO'S CURRENCY OPTION WRITING PROGRAMME

Background

The Banco de Mexico started a peso call/US dollar put option writing programme in August 1996 that is still operating today. Every month, the bank auctions the currency options with a notional size of around US$200-250 million. The primary purpose of the programme is to accumulate foreign reserves passively, without the need to intervene in the spot market and signal to the market the level of intervention.

Basic Features of the Currency Option

The Banco de Mexico auctions the contracts on a monthly basis to the country's credit institutions and receives option premia in return. The buyers of the options have the right to sell a predetermined amount of US dollars against pesos to the central bank on any working day chosen by the holder while the contract is in effect (i.e. the option is American as opposed to European). Nevertheless, unlike the plain vanilla type option with a pre-specified strike price, a floating strike is adopted. This is the 'fix' price announced by the central bank each day, based on a measure of the average exchange rate obtained from a survey of domestic credit institutions on the previous day. The option holder can only exercise the option if the fix price is not higher than the arithmetic moving average of the fix prices of twenty working days prior to the day when the right is exercised.

The restriction on the exercise of the option ensures that the central bank will not acquire foreign reserves when the peso is depreciating. Consider the case when the peso rebounds on a single day after depreciating for some time. Without the restriction on option exercise, option holders will immediately exercise the put option by selling US dollars to the central bank at the previous day's fix price and buying US dollars back in the open market to gain the differential. This will suppress the early signs of peso recovery, as both the central bank and the option holders are scrambling for US dollars. The 20-day moving average restriction reduces the likelihood of the option being exercised when peso has been depreciating.

Effects of the Currency Option Writing Programme

In terms of meeting its objective to build up foreign reserves, officials of the central bank consider the scheme successful. In the last three years, nearly US$10 billion have been acquired under the scheme.[22] Given the floating strike price and the restriction on exercising the option, it is more costly for the central bank to buy from option holders than on the spot market. Nevertheless, these features of the scheme enable the central bank to build up its reserves passively, subject to the exercise of options by holders, and thus avoid sending signals to the market about its intervention level. Moreover, the extra cost of building up reserves is partly offset by the premium revenue earned by the bank.

On the effect on the spot exchange rate, central bank officials thought the impact of the scheme was insignificant, taking into account the small size of the outstanding options relative to the daily turnover of US dollar transactions, which amounted to US$10-12 billion.

22 The total net international assets of Mexico increased from US$6.3 billion at end-December 1996 to US$26.6 billion at end-September 1999.