OPTIONS ON DEBT INSTRUMENTS FOR AUSTRALIAN INVESTMENT MANAGERS

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INTRODUCTION

Markets for options on a wide variety of financial instruments have emerged in recent years. Their development has been a response to increased price volatility in financial markets which has subjected participants to greater risks forcing them to seek instruments which enable reallocation of risks to those better able and/or more willing to bear it. Options currently available include options on foreign currencies, on stock indexes and stock index futures, on gold futures, on short and long term debt instruments and on futures on these debt instruments.

This paper provides a general introduction to options on debt instruments ("debt options"). It focusses on applications of debt options of particular relevance to investment/portfolio managers. Approaches to the valuation of debt options are also considered.

DEBT OPTIONS : TERMINOLOGY & CONCEPTS

Terminology

A debt option entails the right but not the obligation to either buy or sell a commodity which in this case is either a cash market debt instrument (such as a bank bill or a bond/debenture) or a futures contract on the actual debt instrument. There are two types of options: a call option which gives the taker or buyer of the option the right to purchase a stated debt instrument or a futures contract on the underlying instrument at a specific price during a specified period; and a put option which gives the buyer the right to sell a specific debt instrument or a futures contract on the underlying instrument at a specific price during a specified period of time.

There are a number of key elements of a debt option:—

(1) Underlying Commodity — the option must relate to a clearly identified commodity, i.e. a readily identifiable debt instrument or a futures contract on the debt instrument. For example, a call (put) option on a physical 90 day bank bill would give the buyer the right to purchase (sell) a 90 day bank bill as specified; while a call (put) option on a bank bill futures would give the buyer the right to take up a bought (sold) position in the relevant futures contract (the specific futures contract may or may not enable physical delivery against a futures position).

(2) Strike or Exercise Price — the price for which the relevant instrument or futures contract can be bought (in the case of a call option) or sold (in the case of a put).

(3) Exercise, Expiration or Declaration Date — the date on which an option expires, i.e. after which the option can no longer be exercised. Almost all debt options are American rather than European options; that is, the option is capable of being exercised by the holder at anytime up until the expiry date (European options are capable of exercise *only* on the specified expiry date).

(4) Option Premium — the price paid by the buyer of an option to the writer or seller of the option.

Options on Cash Instruments Vs Options on Futures

Options on both cash market debt instruments (i.e. actual physical securities) and futures on the relevant debt instrument currently co-exist despite the fact that a cash market, a futures market and one options market will usually be sufficient to fulfil all risk transfer possibilities since the option on the cash market and the option on the futures market serve similar functions[1].

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Options on futures are generally considered to offer significant advantages over options on actual securities for a number of reasons including:—

- The underlying commodity in futures options is standardised. The exact specifications of the futures contract is known whereas options on specific securities will clearly be less homogenous.
- The supply of futures, the underlying commodity for a futures option, is not subject to the same limitations as options on actual securities which will be constrained by the deliverable supply of specific securities.
- The pricing behaviour of futures options will reflect the generally "efficient" pricing of the futures markets[2], which combined with the homogeneity of the underlying commodity will facilitate a more efficient and competitive market place for the options.
- The futures price is universally accepted and instantly available during trading hours and widely disseminated in the media. Prices on specific financial securities, in contrast, are less accessible and certain and would generally entail canvassing a widespread professional dealer network. This difference between the futures and cash markets also favours futures options.
- Options on futures — unlike options on actual securities — are usually traded at the same physical location as futures and are also processed by the futures clearing system (which significantly reduces the credit risk of the transaction as the clearing house is always one party to the contract) facilitating both trading and exercise of the option (which is easily accomplished by book entry).

In distinguishing between options on cash market debt instruments and options on the corresponding futures market, it is important to note that for cash market debt options, the limited (and declining) life of the underlying security presents special problems. Unlike other cash market financial instruments (e.g. equities, foreign currencies, stock indexes, gold etc.) which have infinite lives or futures contracts which are not based on a particular, wasting debt security, but rather on a security with particular characteristics, actual physical debt securities are affected by the passage of time is debt instruments get closer to maturity as the option gets closer to expiration. This feature necessitates that debt options on cash market instruments take one of two forms : fixed deliverable, whereby a debt instrument with specified characteristics is required to be delivered; or variable deliverable, whereby a specified existing debt issue is required to be delivered. For instance, a six month call option on a 90 day bank bill (the 13.5 per cent May 1994 Commonwealth Government Bond) which requires delivery of a bank bill with 90 days to maturity (the 13.5 per cent May 1994 — irrespective of remaining term to maturity) is an example of a fixed (variable) deliverable option.

In this article, the term debt option is used to cover both options on the cash instrument and options on futures contracts on the relevant physical security.

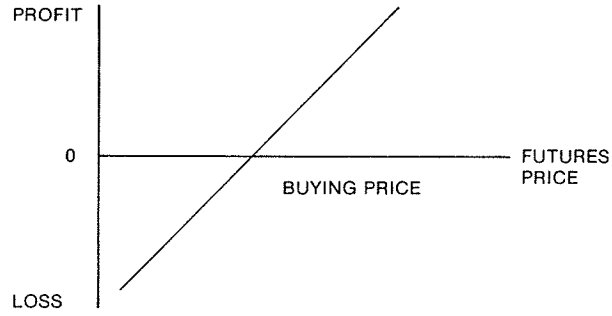
Debt Options : Concepts

The essential economic rationale for futures markets and for debt options market is their role in "insuring" against or "shifting" interest rate risk. Consequently, and understanding of the rewards/risks attached to futures and options is critical. The pay-off to buyers and writers of call and put debt options as well as bought and sold futures positions are set out in *Figures 1, 2,* and *3.*

The differing financial characteristics of options are clearly evident. Gains or losses on open futures positions are limited only by the price of the underlying commodity while, in contrast, the option

FIGURE 1

PROFIT/LOSS ON BOUGHT FUTURES POSITION



PROFIT/LOSS ON SOLD FUTURES POSITION

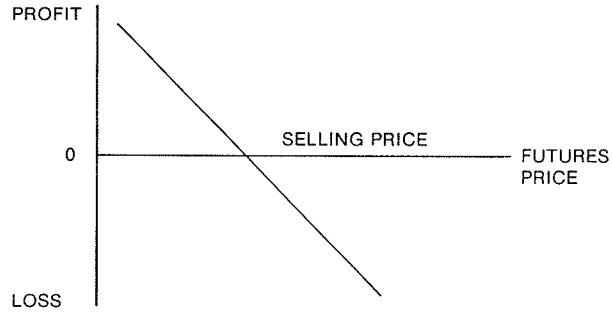


FIGURE 2
PROFIT/LOSS TO BUYER OF A CALL OPTION

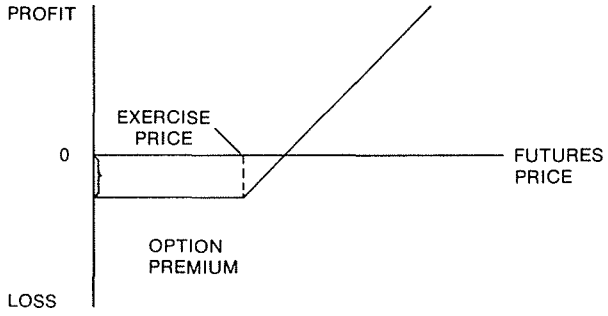
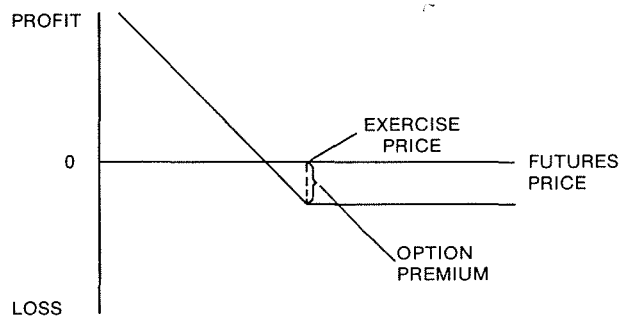
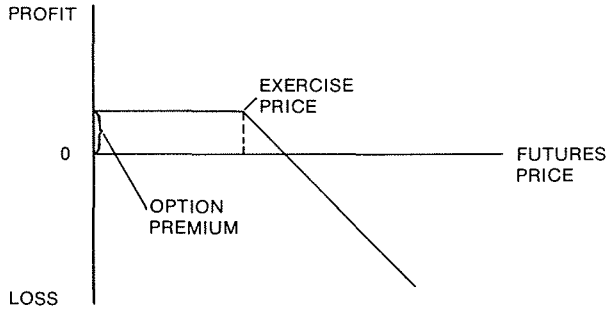


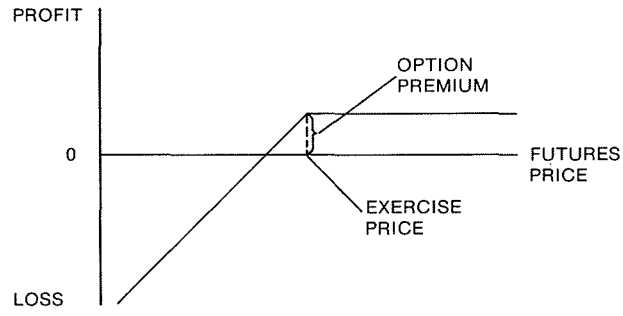
FIGURE 3
PROFIT/LOSS TO BUYER OF A PUT OPTION



PROFIT/LOSS TO WRITER OF A CALL OPTION



PROFIT/LOSS TO WRITER OF A PUT OPTION



separates the buyer's upside and downside risk. The purchaser of a call (put) retains upside (downside) profit opportunities : the net profit on a purchased call (put) equals the underlying asset's increase above (decrease below) the option's exercise price minus the premium. As the option is exercised only at the purchaser's discretion, the *maximum* loss is limited to the premium paid when the position is established i.e. the purchased option can be considered a limited-risk instrument.

There is no comparable limitation on the risk of the option writer. The option writer's profit is the premium received, while his *potential* loss equals the adverse movement of the underlying asset's price from the option's exercise price, less the premium, i.e. the option writer is guaranteed a gross return equal to the premium, but his net return may be less, since he may suffer a virtually unlimited loss.

The utility or role of options is best considered from the starting point of a conventional futures transaction. As it is well known and understood a futures contract can be used to hedge or "lock-in" a price, e.g. an interest rate on a financial instrument. Thus futures, in their conventional form, gurarantee or fix a *certain* price. It is important to note that the hedger is precluded from benefiting from any gain (should rates move in his favour) as well as being insulated from any loss (if rates move in an unfavourable direction).

Options, in contrast, enable the hedger or participant to limit the risk of any loss *but do not preclude him from benefiting from any gain resulting from fluctuations in interest rates.* To extend this concept to specific transactions, debt options would enable a borrower to fix a *maximum* cost of borrowing without preventing him from enjoying a lower cost of debt if interest rates decline. Conversely, an investor would be able to fix a *minimum* return on his investment but would, if interest rates increased, be able to take advantage of higher interest rates. Consequently, debt options, in a sense, overcome a significant deficiency of conventional futures on debt instruments enabling participants to limit risk without the need to sacrifice possible profits from favourable changes in the interest rate environment.

Debt Options : Examples

The risk management potential of debt options can be illustrated by the following example:

In September, an organisation becomes aware of an expected cash receipt (outflow) in December which it will need to invest for 90 days in bank bills (need make drawings under a bill line). The prevailing futures rate

is 12 per cent and is considered attractive and the organisation decides to hedge. Its hedging alternatives are as follows:

(1) Hedge with futures i.e. "lock-in" an investment (borrowing) rate of approximately 12 per cent by buying (selling) December bank bill futures.

(2) Hedge with debt options i.e. set a minimum investment return (maximum borrowing cost) of approximately 12 per cent but leave open the possibility of benefiting from increases (decreases) in interest rates by buying call (put) option on bank bills (either on the physical instrument or on the bank bill futures contract) with an exercise price equivalent to 12 per cent p.a. exercisable as at December for a premium of approximately 0.25 per cent p.a.

The results of the alternative strategies are summarised below:

Table 1

INVESTMENT (BORROWING) RATES UNDER ALTERNATIVE STRATEGIES (%pa)

Hedging Strategy	Scenario 1 Interest Rates Decrease to 10%	Scenario 2 Interest Rates Increase to 14%
Unhedged	10 (10)	14 (14)
Futures Hedges	12 (12)	12 (12)
Options Hedge	11.75 (10.25)	13.75 (12.25)

NOTE: Rates under the option hedge strategy are calculated on the basis of rational exercise i.e. call (puts) are assumed to be exercised where prices rise (fall) or correspondingly rates fall (rise); all rates under the option hedge are calculated net of the option premium assumed.

The results indicate that the strategies involving debt options give a slightly lower investment return (higher borrowing costs) where rates decline (increase) relative to a futures hedge strategy (principally, as a result of the cost of the option) but have significant advantages, as outlined previously, if rates increase (decrease) as it enables the organisation to take advantage of favourable movements in interest rates.

Trading in futures contracts on the underlying debt instrument may be combined with debt options to achieve indentical results to those outlined above (the critical variable being the relative cost of put versus call options). For example, the organisation could as an alternative to purchasing call (put) options have taken bought (sold) positions in the bank bill futures contract in December, while simulataneously buying put (call) option to lock-in the right to close out or offset the futures position at a specified rate.

It is important to note that the decision to hedge using debt options is not independent of expectations of the future spot interest rate. Debt options should only be the preferred exposure management strategy where there is considerable upside potential as well as downside risk. Where only downside risk is perceived, a conventional hedge using relevant futures markets is likely to be superior because of the extra cost of the option.

DEBT OPTIONS : APPLICATIONS

Potential Users

Debt options offer corporate treasurers, investment/portfolio managers, banks and other financial intermediaries a viable means of hedging a range of interest rate exposures.

Corporate treasurers can use debt options to set a maximum (minimum) rate on prospective offerings of short or longer term debt (on short term investments) while preserving the opportunity to benefit from rate declines (increases). Debt options may also be used to hedge uncertain borrowing (investment) commitments or cushion the effects of rate increases on variable rate liabilities and of rate declines on short term investments.

Investment/Portfolio Managers can use debt options to reduce the risks of investing in the underlying instrument. Debt options can be used to protect securities against increases in market yield (price falls) or to lock in minimum investment returns to protect against the opportunity cost or re-investment risk associated with proposed investment of funds. Debt option writing programs can be used as an integral part of a fixed income portfolio management strategy to stabilise portfolio returns and/or increase returns over prolonged holdings periods.

Banks and other financial intermediaries can utilise debt options as part of an overall asset-liability management strategy to protect the bank against an increase (decrease) in rates on its short or long term liabilities (variable rate assets) or to adjust the rate of sensitivity of either assets or liabilities if a maturity imbalance exists. Debt options can also be used to structure facilities that meet borrowers (depositors) needs such as a maximum (minimum) rate on loans (deposits).

In addition to hedging activities, debt options can be used for straight position taking. Speculators may utilise debt options to profit from views on the direction as well as the volatility of interest rates on a

variety of instruments with limited risk as their maximum loss is limited to the price of the option, at least, where the option is taken rather than written.

The focus of this paper is on applications, detailed below, of particular relevance to investment managers.

Investment/Portfolio Management Applications of Debt Options

Debt options provide opportunities for investment managers to increase and/or stabilize returns on fixed interest portfolios:—

(i) Hedging debt portfolios —

Purchase of a put option on, for example, a bank bill (government bond) can protect the value of the institution's portfolio of short term investments (longer term fixed-interest securities) against the risk of increased interest rates.

EXAMPLE A

In September, ABC Superannuation Fund ("ABC") are holding 10 year Commonwealth Government Securities ("CGS") yielding the current market rate in its portfolio. The interest rate outlook is uncertain between now and December and the investment manager is concerned with the possibility of declines in the value of the portfolio as a result of higher interest rates. 10 year CGS are currently yielding 13 per cent, December expiry put options on 10 year CGS with exercise price equivalent to 13 per cent are quoted at a premium of 0.50 per cent. To protect the value of the portfolio, ABC purchases put options for 10 year CGS.

The results of this hedging strategy are as follows:

Interest Rate on 10 year CGS as at December (% p.a.)	Profit (Loss) On Put Options Purchased (% p.a.)	Profit (Loss) on Physical 10 year CGS (% p.a.)	Profit (Loss) On Put Purchase (% p.a.)
10	(0.50)	3.00	2.50
11	(0.50)	2.00	1.50
12	(0.50)	1.00	0.50
13	(0.50)	—	(0.50)
14	0.50	(1.00)	(0.50)
15	1.50	(2.00)	(0.50)
16	2.50	(3.00)	(0.50)

NOTES:

(1) Profit (Loss) is calculated as the difference between the interest rate on 10 year CGS and the option exercise price (the premium).

(2) Profit (Loss) on physical 10 year CGS investments is calculated as the interest rate as at December and the yield on bond.

(3) Profit (Loss) on put purchase strategy is (1) plus (2).

The put purchase strategy, for the cost of the option which slightly diminishes the value of the portfolio, protects the investment against any decline in value (beyond the value of the premium) but allows the portfolio to benefit from increases in CGS prices.

(ii) Hedging interest rate exposures on future investments —

Purchase of call options on debt instruments can be used to fix minimum returns of planned investments (both in short and longer term instruments) or portfolio roll-overs/re-investment enabling the institution to take advantage of any significant increase in returns by the time funds become available for investment.

EXAMPLE B

ABC are aware of a need to invest $1m in long term fixed interest securities in December as existing investments mature. ABC anticipate yields on 10 year CGS (the likely investment) will decline, but feel there is some chance that they may increase. Current yields are 13 per cent p.a. call options on 10 year CGS with an exericise price equivalent to 13 per cent are quoted at 0.50 per cent. ABC decides to hedge its return on the proposed investment by purchasing December calls on 10 year CGS. The results of this hedging strategy are as follows.

Interest Rate on 10 year CGS as at December (% p.a.)	Profit (Loss) on Call Option (% p.a.)	Investment Yield Yield on Purchase of 10 year CGS (% p.a.)
10	2.50	12.50
11	1.50	12.50
12	0.50	12.50
13	(0.50)	12.50
14	(0.50)	13.50
15	(0.50)	14.50
16	(0.50)	15.50

NOTE:
Investment yield in December purchase of 10 year CGS is calculated as the sum of the market interest rate as at December plus the profit (loss) on the option.

Where there is no need to defer the investment, i.e. funds are available immediately, a hedging strategy which can stimulate the protection of purchasing calls to lock in a minimum investment return entails immediate purchase of the physical security in conjunction with the simultaneous purchase of put options on the designated security. This strategy separates the investment and pricing issues as the purchased calls enable the investor to take advantage of any significant increase in rates through increases in

the value of the put during a specified period after the investment (i.e. up until the expiry of the option).

(iii) Writing debt options —

Institutions can engage in covered call option writing against physical securities held in portfolio with the premium received being used to "gross-up" portfolio returns. Put options may be written against planned investments and/or portfolio roll-overs.

EXAMPLE C (1)

Consider the scenario outlined in Example A. Instead of purchasing put options to hedge its portfolio value, ABC writes call options expiring in December with an exercise price equivalent to 13 per cent in return for receiving an option premium of 0.50 per cent.

The results of this strategy are as follows:

Interest Rate on 10 year CGS as at December	Profit (Opportunity Loss) on Options written	Profit (Loss) on Physical 10 year CGS investment	Profit (Loss) on Call Writing Strategy	Profit (Loss) on Put Purchase Strategy
(% p.a.)	(% p.a.)	(% p.a.)	(% p.a.)	(% p.a.)
10	(2.50)	3.00	0.50	2.50
11	(1.50)	2.00	0.50	1.50
12	(0.50)	1.00	0.50	0.50
12.5	—	0.50	0.50	—
13	0.50	—	0.50	(0.50)
13.5	0.50	(0.50)	—	(0.50)
14	0.50	(1.00)	(0.50)	(0.50)
15	0.50	(2.00)	(1.50)	(0.50)
16	0.50	(3.00)	(2.50)	(0.50)

NOTES:

(1) Profit (opportunity loss) on call options written are calculated as the interest rate on 10 year CGS as at December less the option exercise price adjusted for the option premium received.

(2) Profit (loss) on call writing strategy is calculated as (1) plus the profit (loss) on physical 10 year CGS investment.

EXAMPLE C (2)

Consider the scenario in Example B. Instead of purchasing call options to hedge its investment yield, ABC writes put options expiring in December with an exercise price equivalent to 13 per cent p.a. in return for receiving an option premium of 0.50 per cent. The results of this strategy are shown in the table in the next column.

Writing calls (puts) against physical security positions does not provide the absolute protection against rate increases (decreases) that the purchase of a put (call) affords and also entails an "opportunity" loss where rates decrease (increase) sharply. However, covered option writing does stabilize and/or improve portfolio return. The stabilizing influence that a covered call writing program can bring to returns over a succession

Interest Rate on 10 year as at December	Profit (Opportunity) Loss) on Put Option written	Investment Yield on Purchase of 10 year CGS CGS (1) Put Option Writing Strategy	(2) Purchase Call Option Strategy
(% p.a.)	(% p.a.)	(% p.a.)	(% p.a.)
10	0.50	10.50	12.50
11	0.50	11.50	12.50
12	0.50	12.50	12.50
12.5	0.50	13.00	12.50
13	0.50	13.50	12.50
13.5	—	13.50	13.00
14	(0.50)	13.50	13.50
15	(1.50)	13.50	14.50
16	(2.50)	13.50	15.50

NOTES:

(1) Profit (Opportunity Loss) on the put options written are calculated as the option premium where the option is unexercised and as the difference between the option exercise price and the interest rate on 10 year CGS as at December adjusted for the option premium received where the option is exercised.

(2) The investment yield on the purchase of 10 year CGS under the put option writing strategy is calculated as the market interest rate plus the profit (opportunity loss) on put options written.

of shorter holding periods is significant. Importantly, unlike portfolio management techniques, such as immunisation, which can be used to pre-establish returns on limited pools of funds for limited holding periods, covered option writing can be used to stabilize an entire portfolio on an open-ended basis. Whether portfolio returns can be increased, as well as stabilized, by covered option writing depends on a number of factors such as option premium levels in relation to bond-market volatility. For example, where rates remain relatively stable, covered option writing may significantly enhance portfolio returns.

VALUATION OF DEBT OPTIONS

Approaches to Valuation

The premium or price of an option at a particular time (and increases and decreases in the premium) are the major determinants of the profitability of hedging and investment strategies utilising options. In a sense, the primary determinant of option premiums is supply and demand or competition between buyers and sellers; options premiums must be high enough to induce sellers to write them and low enough to induce buyers to purchase them. One of the principal functions of an exchange is to, in fact, provide the facilities and establish the trading rules needed to assure that such a "consensus price" is determined in a competitive environment. However, it is necessary to understand also the fundamental determinants of option premiums and the principal factors that influence them.

In determining the value of an option it is possible to distinguish between: the intrinsic value and the time value of an option. An option's intrinsic value is based on the difference between its exercise price and the current price of the underlying instrument. If an option is currently profitable to exercise, it is said to have intrinsic value; that is, a call (put) option has intrinsic value if the current price of the instrument is above (below) the option's exercise price. Whether or not the option has intrinsic value, it may have time value (defined as the excess of the premium over the option's intrinsic value). The time value of an option reflects the amount buyers are willing to pay for the option reflecting the possibility that, at some time prior to expiration, it may become profitable to exercise.

Most valuation models for options make use of the concept of a riskless portfolio comprising an option and the security that underlies the option. This portfolio is continuously adjusted to ensure that the underlying security and the option are held in the proportion whereby price movements in one are offset by opposite price movements in the other — that is, risk is eliminated. As in equilibrium, riskless portfolios will not return in excess of the risk-free rate of return, the risk-free portfolio may be used to solve the theoretical value of the option.

A number of key assumptions underline this valuation approach including: efficient, frictionless capital markets and security prices follow a continuous stochastic process (or, in the case of binomial option pricing, a multiplicative binomial process). While these assumptions may not hold strictly in reality, valuation models built upon them can provide useful approximations of an option's value[4].

There are two basic (related) approaches to solving the option pricing problem: the first, using binomial distributions, is based on an intuitive approach; the second, derived using stochastic differential equations, is the famous Black-Scholes option pricing model.

Binomial Option Pricing Models

This approach assumes that the security price obeys a binomial generating process and that the relevant option cannot or will not be exercised prior to expiration (an European option). The valuation process begins by considering the possibility that the price can move up or down over a given period by a given amount. This enables calculation of the value of the call option at expiration of the relevant period (which is always the greater of zero or the price of the instrument minus the exercise price). The riskless hedge technique starts at expiration and works backwards in time to the current period for a portfolio consisting of the physical security sold short or one sold futures contract on the relevant security and one bought call option. Since the portfolio is riskless, it must return the risk-free rate of interest over the relevant period. The derivation of the value of the call option using this approach is predicated on the fact that the call option must be priced so that the risk-free hedge earns exactly the risk-free rate of return. The binomial model can be extended from the one-period model to cover multiple time periods to show how an option's time to maturity affects its value.

Cox, Ross & Rubenstein (1979) provide a binomial option pricing model for equity stocks which can be adapted for valuing options on physical debt instruments. Ramaswamy & Sundaresan (1983) develop a valuation model for options on futures contracts (including those on debt securities) which can be solved utilising numerical methods. A significant advantage of the binomial approach is that it provides solutions not only for a closed-form European option pricing model but also for the more problematic American option pricing problem where numerical simulations must be employed.

Black-Scholes Option Pricing Model

The binomial option pricing model contains the Black-Scholes formulation as a limiting case. The continuous time option pricing formula for European options, derived by Black and Scholes (1973), was developed originally for stock options and can be utilised to value options on physical debt securities. The value of a call option is given by the formula:

$$C = S.N(d_1) - E.e^{-RT} N(d_2)$$

$$d_1 = \frac{\ln(S/E) + RT + [(1/2)V^2T]}{V\sqrt{T}}$$

$$d_2 = d_1 - V\sqrt{T}$$

where: C is the price of a European call; S is the price of the underlying commodity; T is the time to exercise date; E is the exercise price of the option; V is the standard deviation of the per cent change in S per unit of time; R is the risk free rate continously compounded; and N(d) is the cumulative normal probability density function.

Black (1976) adapts the original Black-Scholes valuation formula for use with options on futures contracts. The

value of a call option on a futures contract is given by the formula:

$$C = e^{-RT}[F.N(d_1) - E.N.(d_2)]$$

$$d_1 = \frac{\ln(F/E) + [(1/2)V^2T]}{V\sqrt{T}}$$

$$d_2 = d_1 - V\sqrt{T}$$

Where: F is the price of the underlying futures contract; V is the standard deviation of the per cent change in F per unit of time; and all other notation is as before.

The intuition behind the Black formulation of the Black-Scholes option pricing model is that: firstly, investment in a futures contract requires no commitment of funds, whereas investment in the physical commodity, for example, the stock in the case of a stock option, imposes a cost; and secondly, the value of a call option on futures should be lower than the value of a call option on the physical commodity, since the futures price should already impound the carrying costs associated with the physical commodity.

The price of a put option can be derived utilising the process of put-call parity. For European options on the underlying instrument:—

$$P - S = C + E.e^{-RT}$$

Where: P is the price of a European put.

For European options on futures contracts:

$$C - P = (F - E)e^{-RT}$$

Factors affecting options price

The valuation approaches discussed highlight five variables that affect the price of a debt option —

1. the current price of the underlying instrument;
2. the exercise price;
3. the risk-free rate;
4. the time to expiry; and
5. the volatility of prices on the underlying asset or the futures contract.

Volatility or variance is the only factor not directly observable. Volatility measured over past periods is generally used as a proxy for variance over the life of the option.

The general effect of each relevant variable on the value of a debt option (where all other variables are held constant) can be summarised as follows:

Increase in	Affect on Call Price	Affect on Put Price
Price of Instrument	Increase	Decrease
Exercise Price	Decrease	Increase
Risk Free Rate	Unclear	Unclear
Time to Expiry	Increase	Increase
Volatility	Increase	Increase

The effect of changes in the time to expiration and in the risk free rate require comment. For options on stocks, stock indexes, currencies and on variable deliverable debt instrument, an option with a longer time to expiration will be worth more than a comparable option with a shorter term to expiry on the basis that it has all the attributes of the nearer option plus more benefits for the holder, i.e. there is greater probability that the option can be profitably exercised. This pricing property need not necessarily hold for options on futures or fixed deliverable option, although it will generally be the case. Depending on the relative magnitudes of the time value and the intrinsic values, it is conceivable that, under certain circumstances, an option with a longer time to expiration may be worth less than one with a shorter term.

For options on stocks, as the risk free rate increases, the value of a call option increases as the present value of the exercise price in the event of exercise declines; that is, if the call option and the security itself are regarded as different ways for an investor to capture any gain on the security price, as rates rise the increased cost of carry on the underlying security will make the call more attractive leading to an increase in its value. For options on futures contracts there is no opportunity cost associated with holding a futures contract as no funds need be expended until expiration[5]; consequently, the interest rate effect will generally be negative although very small.[6] More importantly, it is unreasonable to assume (as is usually done in the case of equity options), that the price of the underlying security is independent of the level of interest rates. Significant movements in the prices of debt instruments will occur as a result of change in interest rates and, in general, any cost of carry considerations will be minor relative to the change in the value of the underlying security. Rate increases will usually have a negative impact on the price of call options on debt instruments as a rise in rates will most likely cause a fall in the price of the underlying instrument or futures contract.

The approaches to valuation considered focus on pricing European options. It is important to note that, if all other factors are identical, an American option is at least as valuable as and generally never less valuable than a European option because the owner of an American option has every right — and more — than the owner of the corresponding European options.

THE MARKET FOR OPTIONS ON FUTURES

As noted above, extensive markets for debt options (most notably on Treasury Bills and Bonds, Currencies and Stock Indexes) have developed in the United States. The Sydney Futures Exchange ("SFE") introduced its commodity options contract in March 1982, being among the first exchanges to introduce the facility.[7]

The SFE commodity options facility has not been as successful as expected for a number of reasons. The lack of understanding of options and the absence of option writing interest has impeded the development of the market. A major reason for the lack of interest in the facility appears to have been the fact that the commodity options contract as presently constituted requires an option, once taken, to be either exercised or abandoned (allowed to lapse) with transfer to a third party not being allowed. This is in marked contrast to the US where such options are freely traded, prior to expiry, on the relevant exchanges. In the US, the majority of holders do not in fact exercise the options to take positions in the physical commodity or futures contract but choose rather to simply buy or sell options, realising their profit or loss from the increase or decrease in option premiums.

It is understood that the SFE are considering changes to the commodity options contract to make such options freely tradeable on the exchange. This change in the rules combined with an increasing level of interest in debt options from Australian organisations appears likely to accelerate the development of this market in the near future.

SUMMARY AND CONCLUSIONS

Options on debt instruments represent an important innovation in financial markets. This article has sought to outline the concept of debt options and identify potential applications of the instrument. Approaches to valuation of debt options were also examined.

The potential utility of options in portfolio and corporate financial management is related largely to the emergence of a competitive and liquid market in such instruments. However, as developmental problems are overcome, through increased understanding on the part of potential users of the markets concerned, debt instruments are likely to emerge as an important risk management instrument for corporate treasurers, portfolio managers and financial institutions.

FOOTNOTES:

1. For example, in the limiting case, an option on a futures contract (the specifications of which allow settlement by physical delivery) which expires on the day the futures contract is delivered, delivery on the option would be settled immediately providing the actual physical security; consequently, no useful distinction would exist between an option on the cash instrument and an option on the futures.
2. For tests of the market efficiency of, for example, the interest rate futures markets see articles by: Branch; Capozza and Cornell; Lang and Rasche; Poole, Puglisi; Rendleman and Carabine; and Vignola and Dale; reprinted in Gay and Kolb (1982).
3. As in interest rate futures markets, given the lack of debt options corresponding to every financial instrument in the physical market, hedges must be structured using existing options contracts that demonstrate similar price fluctuations with the physical instrument being hedged. In the Australian context, promissory notes, non-bank bills etc. (all of which show a high statistical correlation with bank bills) may be hedged using options on physical bank bills or on the SFE bank bill futures contracts, while longer term debt instruments can be hedged using options on Commonwealth Government Bonds or on the SFE Treasury Bond futures contract.
4. For example, the Black-Scholes valuation formula assumes that the stock's continuously compounded return follows a normal distribution with a constant variance; its expiration price will, consequently, conform to a log normal distribution. While such an assumption is tractable for equities, it may not be an accurate simplification for variable deliverable debt instruments which do not have a perpetual life and on which, even if interest rates remain constant, the declining period to maturity will cause the price of the instrument to change and, generally, its variance to decline i.e. as maturity approaches, the debt instrument will be valued closer to par, all other factors being constant.

5. Deposits, margins etc. are ignored; in reality, the effect of these costs is minor.
6. It is important to note that there are, in effect, two distinct and separate interest rates which are relevant. Firstly, there is the interest rate on the underlying debt instrument, and, secondly, there is the interest rate in effect for short-term borrowing and lending for a period corresponding to that between the date as at which the option is being valued and the option's expiration date. The latter is usually referred to as the risk free rate. Where the interest rate or yield on the underlying security or futures contract falls, that is, the price increases, the call option becomes more valuable; where the risk free rate at which short term borrowing and lending is possible falls, the value of the call decreases.
7. Options on the gold, silver, wool, trade steers, 90-day bank bill and US dollar futures contract are currently available on the SFE.

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