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HEDGING OFFICE RENTAL DECISIONS

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Introduction

Life is a long and sometimes invisible chain of options. An option (or more precisely an alternative[1]) is the implicit or explicit opportunity to postpone a decision. The postponement of a decision allows the decision- maker to acquire more information and, hopefully, to make a better choice. Our daily life and, more to the point, our business life is filled with various options. Some options are implicit and unpriced (a lunch date, an engagement to marry, a restaurant reservation). Some are implicit but priced (a divorce, a tertiary education, an engagement ring) and, finally, some are explicit and priced (a trip cancellation insurance, a mortgage insurance premium and, of course, options on securities or properties).

Explicit financial options have always existed, but became an academic world on itself in the field of finance after the discovery of a satisfactory pricing formula based on the pioneering (and totally neglected work) of Bachelier as early as 1900[1]. Then the different attempts by Sprenkle [2], Boness [3] and Samuelson [4] matured into the Black-Scholes (1973)[1] pricing formula which became the standard analytical tool in most of the traditional option literature.

Trigeorgis [5] mentioned that "the potential for future applications itself seems like a growth option" and indeed the growth has been spectacular in Finance and some related disciplines. For example, beyond the pure option pricing research, option analogical treatments have been applied to general Capital budgeting (MacDonald and Siegel [6], or Dixit and Pindyck [7] to resource economics Kester [8] and [9], Marson and Merton [10]), Brennan and Schwartz ([11], Morck, Schwartz and Strangeland [12] and to research and development investment analysis Copeland, Koller and J. Murrin ([13]

The treatment of land and property options had a comparatively slower start. The first attempts in describing and pricing property options did not commence until the 1980. Kummer and Schwartz[14] , Achour and Brown[15], Brown and Achour[16] and Titman[17]

But since then, the option analogies have proliferated throughout the real estate literature in many directions. A sample of such treatments can be found in mortgage

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[1] An alternative (*stricto sensu*) is a choice between two states of the world. An option is the choice between any number of states of the world. The distinction has more or less disappeared from the common language and, in any case, does not create a major analytical problem since any option can be decomposed into a chain of successive alternatives.

pricing Ling [18], Murphy [19], Schwartz and Torous [20], Foster and Van Order [21], Follain and Park [22], in the analysis of development timing Capozza and Helsley [23] or in leasing contract Valuation Capozza and Sick [24].

In leasing analysis, Posner [25] illustrates the different options embedded in leasing agreements and shows that some of these options can be used to hedge against rental variations.

In this paper the land option analogy will be generalised to the concept of an option on a land related index. As we now have options markets on share indices (an indirect option on underlying shares) we could also, by analogy imagine options on indices of land prices or rent levels. In this paper, the analogy between the instruments will first be clarified, then an hypothetical rental option market will be imagined and simulated in order to demonstrate the hedging opportunities offered by such an instrument. A similar treatment has already been suggested as a housing policy tool by Achour and Brown [26]. Needless to say, this concept has still to become part of any country housing policy.

1.1 *Property Options and Stock Options*

Optioning land and other real property rights has always be a riskless way of starting a land development process. Through an option, the optionee (or taker) acquires the right to buy a specific parcel of land at a specified price (the exercise price) on or before some future specific time. The owner of the lot (the optionor or writer) "writes" an option on his asset and receives a cash consideration (the premium paid by the optionee) which represents the money value of the opportunities he foregoes by holding his land in abeyance during the option period.

Usually the optionee uses the option route to gain control of the property with a cash outlay representing a small proportion of the value of the asset. The provisions of land option contracts can be quite complex (see Brown and Achour [16]) but the basic option contract is closely analogous to the financial option instrument now traded on many securities markets.

In this section, we discuss the basic form of the real property option (known as the "fixed option") and draw an analogy with the call American[1] option on common stocks.

The holder of a land option of the "fixed" type has the right to purchase a given property from the landowner at a fixed price at any time prior to a stated future date (the expiration date). The optionee has a choice as to whether the future transaction will occur. Thus an option contract differs from a conditional purchase type of agreement. In such an agreement the putative buyer must proceed with the purchase if all the contingency clauses are performed. The optionee, on the other hand, may "walk away from the deal" at any time at or before expiration, if he so wishes, forfeiting only the premium paid to the optionor.

Usually the optionee would abandon the right to exercise his option if the market value of the land is below the exercise price or, for example, if his feasibility analysis does not satisfy his expectation concerning the development potential of the property. If, at any time, the estimated market price of the property should exceed the fixed purchase price then the option should have some intrinsic value and could be exercised. At any time it could be sold to some other investor and, since an option merely creates a contractual right (not a real property right) such secondary transaction could easily be undertaken.

A major benefit of this contract to the option holder is the leverage aspect: relatively small percentage movements in property values are translated into large percentage movements in option values. Conversely, the property owner receives some immediate cash payment but foregoes any increments in property value in excess of the fixed purchase price.

The common stock counterpart to a fixed option is a call option. Under a call contract the optionee has the right to obtain a specific number of shares of common stock at a fixed price on, or before, a specific expiration date. A call option equates the difference between the stock price at expiration and the exercise price if the difference is positive and is worth nothing if the difference is negative. As with the property option, the call option provides leverage for the option holder and insurance against moderate price declines for the option writer (the optionor).

1.2 The valuation formula for a fixed option on property.

In a world of total certainty with respect to future prices, the value of an option (now) is simply the difference between the market value of the property (now) and the present value of the exercise price (to pay later).

In continuous discounting, the above statement can be written:

$$OP_t = MV_t - e^{-r \cdot T} \cdot X$$

Where Op_t is the value of the option at time t, MV_t is the market value of the land at t and X is the exercise price the optionee has agreed to pay at expiration date.

e^{-rT} is the present value operator at the risk-free discounting rate r for the T time periods remaining between now (t) and the expiration date. For example, if an option is to be exercised in 1 year at the exercise price of $ 1000 per square meter (or any multiple of this sum) when the risk-free rate is 5 % p.a. and the market value of the property has now reached $ 1200 such a contract is worth (and can be sold for) $ 593.47 in our world of total certainty. The longer the period before the expiration date the more expensive will be the option since the present value the strike price is getting smaller with time.

If we now introduce some uncertainty with respect to future prices we may find that, at the expiration date, the value of the option will be exactly (MV - X) if MV - X > 0 and 0P will be equal to zero if MV - X ≥ 0: the optionee will not exercise the option if he must, as a result, pay more than the market value of the asset. But the option may have some positive value before the expiration date even if MV is below the exercise price: this is true as long as there is some probability that the value of the asset might rise above X before the expiration of the contract. In fact, for most land option situations, the market value of the land is below the exercise price when the option is negotiated. The developer expects the value of the land to increase and this expectation is probably the main reason why he is willing to pay a certain "insurance premium" to obtain some control on the future price of the property. In a world of uncertainty about the future market values at each period f, we must make some assumptions on their probable distribution. If we assume that the natural logarithm of (MV_t/MV_{t-1}) is normally distributed, the Black-Scholes solution to our question is given by:

$$OP_t = MV_t.N(d_1) - e^{-r.T}X.N(d_2)$$

$N(d_1)$ and $N(d_2)$ are the cumulative normal distribution values for d1 and d2 and:

$$d_1 = \frac{1n(MV / X + (r + 0.5s^2).T}{s\sqrt{T}}$$

$$d_2 - \frac{1n(MV / X) + (r - 0.5s^2) \cdot T}{s\sqrt{T}} = d_1 - s\sqrt{T}$$

In this formulation, σ is the standard deviation of the distribution of property price variation: It is an indicator of the volatility of the asset price. If, in our previous example, we had assumed that the market value of the property was $ 800 per square meter when the option was taken and that the standard deviation σ was 0.20 (obtained, for example, from historical data on similarly located properties), this option could now be appraised at $18.59 per square meter.

The developer is thus willing to pay $18.59 now to be in a position to pay $1000 in three year's time, for a property whose value now is only $ 800 per square foot.

The price of the option is entirely determined by the five variables, which appear in the Black-Scholes formula.

$OP_t = f\ (MV_{t,} X, s, r, T)$

The relative effect of each variable on the option price is illustrated in figure 1. It can be shown that the signs of the partial derivatives are:

$\frac{\partial OP}{\partial MV} > 0$: The option gains value when the underlying asset appreciates.

$\frac{\partial OP}{\partial X} < 0$: A higher exercise price obviously calls for a lower premium.

$\frac{\partial OP}{\partial s^2} > 0$: The volatility of the asset value increases the value of the option.

$\frac{\partial OP}{\partial .T} > 0$: Similarly, a longer holding period confers on the option holder all the advantages of an "equivalent" shorter option and then some.

$\frac{\partial OP}{\partial r} > 0$: Since an option involves the postponement of an amount x, the present value of options increases with the discounting rate.

These intuitive relationships are illustrated with the same simplified example. Here (see table 1) the values of a European option to be exercised at the price of $1 000 per sq. meter are calculated under different hypotheses.

Table 1: Option values for an exercise prices of $ 1000 per square meter (*)

	T=1 years		**T=5 years**	
	r = 5%	**r = 10%**	**r = 5%**	**r = 10%**

MV=800				
s =.10	1.47	4.46	81.37	201.51
s =.20	18.59	27.89	150.52	243.71
s =.40	75.78	88.96	283.27	350.26
MV=1500				
s=.10	548.77		721.31	
s=.20	549.70		736.23	
s=.40	578.72		844.56	

MV: market value of the property now

T: time to expiration

r: risk-free rate of interest

s: Standard deviation of land prices variations

If the property considered generates rental flows, the analogy with stock options can be extended in order to add the present value of periodic incomes to the basic value of the option. The applicable analogy would be the valuation of a European option on a share when dividends are paid continuously.

The payment of a dividend decreases the price of the share by the exact amount of the paid dividend. Thus a stream of continuous dividends (or rental payments) will decrease the value of the share by the present value of the flow of payments. This formulation is probably more suitable to the treatment of income generating properties, but at this stage, it may be necessary to emphasise that the real property option analogy cannot be pushed too far.

The existence and efficiency of option markets on shares are due to the existence of a very large number of continuous transactions and a large number of market participants (Option writers and holders) who are optioning for shares that are standardised, constantly transacted and submitted to daily price discovery.

The situation is different for property transactions on almost perfectly heterogeneous assets, submitted to infrequent and opaque transactions. The very concept of an option market on such transactions is difficult to transfer and, most importantly here, the option pricing formula would certainly not apply because of the various violations of the required hypothesis. We will now submit that this limitation may not be as severe if we consider option on property indexes.

1.3 Option on Indexes

Financial options are good hedging instruments against the gyration of individual shares. But, for an investor or an Institution that have large and diversified portfolios, it would be costly and sometimes impossible, to protect each and every share of the portfolio with individual options. Options on indices have thus been developed to protect the value of a basket of shares in order to offer an approximation of corresponding portfolios of assets.

In Australia options are traded on the Australian Options Market (AOM) and the Sydney Futures Exchange. Both option markets use the Share Price Index of the Australian Stock Exchange. Share Price Index contracts are "American" options and thus can be exercised at any time up to the expiry date. By contrast Australian Options Market options are "European" options that must be exercised at the expiry time.

Option transactions on the Share Price Index call for resolution by the transfer of Index futures. Options traded on the Australian Options Market are not deliverable and thus must be settled for cash. In the illustration, we will use the AOM model where a $10 multiplier is applied to each index points. Thus, a very simplistic example could be of an optionor who pays a premium of $ 100 in order to "buy" the index at a certain level (let us say 2000) at a specific date.

The payoff table for such a hypothetical transaction is presented in table Table 2. The gain for the optionor is the loss for the optionee but the positions are not symmetrical: the optionor cannot loose more than his premium ($ 100 in our case) but the option writer has no downside protection: he must deliver at the level 2000 however high the index climbs.

Table 2: Payoff table of a simplistic share price index transaction			
Fixed premium	100		
Strike level	2000		
Multiplier	10		
Closing SPI level	Strike price	Benefit for the optionor	Benefit for the
1800	Not exercised	-1000	1000
1900	Not exercised	-1000	1000
2000	Not exercised	-1000	1000
2100	20000	0	0
2125	20000	250	-250
2150	20000	500	-500
2175	20000	750	-750
2200	20000	1000	-1000
2225	20000	1250	-1250
2300	20000	2000	-2000
2400	20000	3000	-3000
2500	20000	4000	-4000
2600	20000	5000	-5000

The general intuition of the pricing of index options is exactly the same as in the case of share options. The price will depend of the level of the index, the discount rate, the time before expiry and, most importantly the volatility of the index. Typically, options will be quite expensive during rocky share market periods and conversely.

1.4 Options on office rental

A simple scenario may help illustrate the concept of index on rental level. A Corporation is planning a major office relocation (or implantation) in two years from now. The Vice-President Property may wish to protect herself against the vagaries of the rental market since she knows that rental rates are highly volatile as illustrated by the variation of the 18 years of net effective rental rate in Perth (Western Australia).

En of the year		Net effective rent	Index Base 1980	Index Variation = Ln (Pt/Pt-1)
1980	$	82.50	100.00	
1981	$	92.50	112.12	11%
1982	$	110.00	133.33	17%
1983	$	117.50	142.42	7%
1984	$	118.50	143.64	1%
1985	$	133.00	161.21	12%
1986	$	190.00	230.30	36%
1987	$	261.00	316.36	32%
1988	$	323.00	391.52	21%
1989	$	342.00	414.55	6%
1990	$	342.00	414.55	0%
1991	$	285.00	345.45	-18%
1992	$	95.00	115.15	-110%
1993	$	95.00	115.15	0%
1994	$	140.00	169.70	39%
1995	$	170.00	206.06	19%
1996	$	205.00	248.48	19%
1997	$	180.00	218.18	-13%
1998	$	230.00	278.79	25%
			standard deviatio	32.72%
			Variance	10.70%

What are her options? (In the common sense of the word).

- She could certainly sign a rental agreement right now and lock-in the present rental rates. This strategy is equivalent to the establishment of a future contract. In such a contract, the price is decided today but the delivery takes place in the future. Future contracts are not submitted to premium payments (except transaction costs) and can be executed by the delivery of the asset or resold on the future market. This form of protection has initially been developed to protect farmers who wanted to lock the price of their commodities (initially corn in the US and greasy wool in Australia). Now most of the futures transactions on the Sydney Futures Market are written on financial instruments and less and less on commodities.

- At this stage, of course, our Vice President cannot trade office space on a futures market but the pre-leasing contract would give her similar protection against future rental increases. Unfortunately she would also be locked at a given rental level and thus will be deprived of the eventual benefits of a drop in rents. Depending on market conditions and the size of our hypothetical corporation, pre-leasing agreement could of course be renegotiated, but for now, we eliminate this possibility.

- She could also try to take a real option on the desired building. We have demonstrated above that property options do exist (mostly on vacant land) and that they can be priced (approximately) under various restrictive conditions. In this case, the optionor would thus have to pay a premium to have the right to walk away from the deal if she could find cheaper or more appropriate office space. But, the option discussed here would be a typical European option that can only be exercised at a given time (in two years in our example) on a given property. Our Vice president may find these limitations too constraining, since, having little faith in her Corporation strategic plan, she still does not know for sure if 1) they will move 2) how much space they will require and 3) when the move will take place exactly. Under present conditions, this type of uncertainty is not exceptional.

- Instead of choosing a very constraining real option on a specific property, our V.P would probably prefer to have a general price protection against variation of rental conditions without linking this protection to a particular space, a particular surface or a particularly exact date. The answer to her problem could be in the form of an option on rental index. Of course this instrument does not exist, so we need to invent it for the sake of the demonstration.

- Thus let us assume thus that a regular index of property rental rates is available for each city and for each general type of office building (Categories A, B, C, etc. or any other acceptable price-related segmentation of the rental market).

- Rental market conditions for high quality office rental could be around $ 200 a square meter. Our Property Vice-President is optimistic about the next two years and assumes that rent will progress and thus is willing to buy the index at a slightly higher level than the present one. ($220). She also prefers to keep her timing and space usage options opened and thus write an American call for a number of units that will be approximately sufficient to cover her predicted needs. Since she does not have very specific requirements about the exact location of the property, she is satisfied that the amount of optioned for space will meet her general price and availability requirements.

- The following table illustrates the possible range of expected premiums to pay for a hedging position on office rental on the Perth market under various timing and interest rate conditions. The results presented in table 3 are obtained through a straight Black-Scholes formula.

- The use of the adapted pricing formula for option on indexes is not appropriate here since our hypothetical rental index is not affected by the payment of dividends.

Table 3 : Option Premiums			
Market price	**200 $ per sq. meter**		
Risk free rate	**5% per year**		
Index volatility	**10.00% per year**		
	Strike prices ($ per sq. meter per year)		
time to maturity (in years)	**200**	**220**	**240**
0.50	**8.38**	**1.23**	**0.07**
1.00	**13.61**	**4.34**	**0.92**
1.50	**18.34**	**7.94**	**2.70**
2.00	**22.82**	**11.72**	**5.11**
2.50	**27.12**	**15.56**	**7.91**
3.00	**31.28**	**19.41**	**10.98**

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- The results shown in table 3 are not meant to be particularly realistic. They are presented here to illustrate the approximate size of premiums per unit of space options. In our previous example, our optionor would have to pay a premium of $ 11 720 to buy the index at the $ 220 rent level to cover her needs for 1 000 m2. If rents go higher, she would sell her options and her profit would compensate for higher rent. If rent drop, she does not exercise her option, loose her premium, but is compensated by a lower level of rent. The hypothetical payoff results are presented in table 4.

- To reinforce the intuition behind this pricing work-out, we also illustrate that premium would be lower if the prospective tenant is willing to option on a higher rent level (here 240 $/m2). Conversely, the option will be more expensive if the tenant tries to obtain a rental level below the current market rate.

- Since our Vice-president had some hesitation about his timing, we also illustrated the price to pay to this uncertainty... obviously, procrastination has to be paid with larger premiums.

- Based on our simulated results, a simple payoff table may illustrate the value of this hedging strategy. The prospective tenant is paying a non-negligible insurance as a protection against rental increases. But, precisely, premiums are high because rental market volatility is high in Perth and thus the price of the protective hedge is correspondingly high.

- In a very stable market, premiums would be much lower but then, who would really require the protection of an option index.

Table 4 : a option payoff example

Market price	200	$ per sq. meter
Time to maturity	2	years
Risk free rate	5%	per year
Index volatility	10.00%	per year
Closing Perth Rental Index level ($ per sq.meter)	Benefit for the optionor ($) par sq. meter	Benefit for the optionee ($)
200	-11.72	11.72
210	-11.72	11.72
220	-11.72	11.72
230	-1.72	1.72
240	8.28	-8.28
250	18.28	-18.28
260	28.28	-28.28
270	38.28	-38.28
280	48.28	-48.28
290	58.28	-58.28

1.5 In lieu of a conclusion

Who would be writing the options?

Our story has been limited to the solution of our Property Vice President relocation anxieties. We found that he, and all the prospective nervous future tenants may find some value in the possibility of protecting their rental position by buying rental index calls. This hedging possibility exists for most market transactions and, in theory at least, an additional option trading floor would offer a more efficient and complete market for office space.

But to have an option market one requires enough call writers to cover the demand from call buyers. The space owners would be the natural counter-actors in this index market. By writing calls, they would generate some compensating revenues when rent levels drop below the exercise price and tenants walk away. Conversely, they would be compensated by the effective increase of the rental revenues in case of rental increase when they are expected to cover the calls. The market index would thus offer a partial insurance coverage for the prospective for the building owners (call writers) and for their potential tenants (call buyers). It would even be conceivable to imagine that builders associations (e.g. the Australian Property Council) could organise a syndication of option writers based on the relative size and values of the members rental portfolio.

What would be the index reference?

This is probably the most difficult practical issue:

> *A tremendous step toward improving our ability to monitor real estate markets would be achieved by creation of an index of effective market rental rates (ie: a lease index). To be useful, such an index must be current and reflect the true cost of different types of space as reflected by actual terms of the leases negotiated at a given point in time by suppliers and users of spaces*

Fisher, 1992 [27]

The construction and the updating of a reliable market-segmented index are quite complex and raise theoretical issues that have been identified Hoag [28] and not satisfactorily resolved Fisher and Webb[29]). A proper index must rely on systematic survey data and constant re-balancing to account for the shifts in office categories representativity. The reliability of the index must also be guaranteed by the neutrality of the index builders. This may require the creation of a statistical trustee that would also act a clearing house (Similar to the Option Clearing House affiliated to the Australian Stock Exchange Board).

The idea has certainly some merit, but unfortunately, at this stage we must still rely on the academic cliché that further investigation will be required to present an acceptable practical solution.

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[1] American options are exercised at any time until the expiration date. European options can only be exercised at the expiration date. The names are historical misnomers. Both American options and European options are traded in American, European and Australian markets. Some indices options can be American options (e.g.; the S and P 100) or European (on the S and P 500). The American format is much more common in Australia.