Property Derivative Pricing

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A conceptual understanding

To understand pricing, it is useful to first understand a conceptual model for pricing, and then later to apply tailored real world adjustments to that theoretical price. For simplicity, the following discussion is taken from a buyer's perspective, but applies equally to sellers.

Investopedia defines a derivative as "A security whose price is dependent upon or derived from one or more underlying assets." In our case we are fortunate that a property future is among the simplest of derivatives. The future is "derived" from a portfolio of properties (the IPD) and the exact payout of the future is:

$$Futures\ Payout = \left[\left(\frac{IPD\ Index_{Final}}{IPD\ Index_{Start}} - 1\right) - FixedRate\right] x\ £50{,}000$$

The keen observer will notice that this formula describes a surprisingly traditional investment in leveraged property; restating the terms makes this readily apparent:

$$Investment\ Profit\ = \left[\left(\frac{Property\ Sales\ Price + Net\ Income}{Property\ Purchase\ Price} - 1\right) - FinancingRate\right] x\ Investment$$

In plain English, we have bought a property portfolio on leverage, collected the income, paid a financing charge, and then sold the investment. The clarity in this comparison is striking and should be reflected upon; one can immediately see the derivative's conceptual underpinning. However, it is equally evident that while the formulae should serve as the foundation for our understanding, real world investments involve a few more details.

The details

A point that should be clear from the formula is that these futures are not either a purchase or sale of the IPD, but rather a purchase AND a sale of the IPD. The futures cover a single year period, after which, one is no longer invested.

To arrive at the theoretical value of the future, we only need to know three things:

- On what dates are we buying and selling the property portfolio (the Index)?
- At what index levels are we buying and selling?
- What is the fixed rate?

We will look at the following example of buying the Calendar 2013 future (settles March 2014) and the Calendar 2014 future (settles March 2015):

Assumptions:
IPD Dec 31, 2012 = 1562.03493
Today's date: March 31, 2013
IPD Dec 31, 2013 = Unknown
IPD Dec 31, 2014 = Unknown
Risk free financing rate is assumed constant at 1%

The Dates:

The dates of the buys/sells are simply defined as the start and end of the respective IPD Index period.
Calendar 2013 contract: Dec 31, 2012 to Dec 31, 2013
Calendar 2014 contract: Dec 31, 2013 to Dec 31, 2014

The Fixed Rate:

On the face of it, the fixed rate is just the risk free financing rate which we shall say is 1%. This is an over-simplification, because the actual rate should be the forward risk free rate for that calendar period. Depending on your beliefs you could use Gilts or LIBOR. But why use a risk free rate in the first place when mortgages have risk? Our transaction is similar to buying a portfolio of property and taking out an 84% LTV loan. It is 84% because the exchange (Eurex) requires the buyer to post cash margin of around 8% per annual contract. 100% - 8% (2013) - 8% (2014) = 84%. However, this loan stays at 84% LTV, because if property prices decrease, the futures buyer must top up their margin (pay cash) on a daily basis to keep the leverage at 84% LTV. Thus, the risk is actually to an overnight loan on the IPD with 16% equity. This lending arrangement may seem unusual, but it exists for many other markets including equities and bonds, currencies and commodities. Those markets all charge a lending rate close to the risk free rate. The theoretical fixed rate in our example is 1.0% x time, but later we will be adjusting it for some more "real world" details.

The Index Levels:

Recall the futures payout formula:

$$Futures\ Payout = \left[\left(\frac{IPD\ Index_{Final}}{IPD\ Index_{Start}} - 1\right) - FixedRate\right] x\ £50{,}000$$

Since we are trading an index, we can conceptually see that our purchase and sale prices are simply the IPD Index levels at the start and end date of the period. However, there are several details to note:

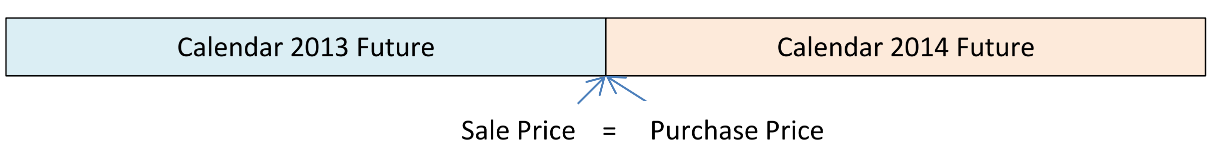
1) For the front calendar futures contract (2013), the starting IPD index level will be in the past, namely the final published value from December 31, 2012. Since this index level is three months old, we will need an adjustment to arrive at a fair purchase price for a property transaction today.

2) All forward year futures (ex. Calendar 2014) start at some point in the future. Hence we do not know today what the starting index value (Purchase Price) will be.

3) All final ending index levels (Sales Price + Income) are also unknown today.

There are several implications of these points on pricing.

- Not knowing the starting index value of the Calendar 2014 contract is not terribly important if one also owns Calendar 2013. This is because the index value on Dec 31, 2013 will be used for both the sale in the Calendar 2013 contract and the buy in Calendar 2014 contract. This is a wash, and highlights that one can create an investment with a longer hold period by chaining together contracts (with a caveat described later).



- It is inadvisable to own the Calendar 2014 contract without also owning all prior contracts (Calendar 2013), because it amounts to agreeing to buy and sell a portfolio in the future, but not knowing even the Purchase Price. This creates a far more complicated exposure whose pricing and risk is widely misunderstood. To see why, think about a sudden consensus increase today in a forward year's forecast total returns, say 2015. If it were truly believed by the market, this would be in the net present value spreadsheets used to value physical property purchases today. Thus, today's capital values would rise, and by that act, the expected increase in 2015 capital values would never happen, because they already happened today. If this were not true, then that means the market doesn't believe the forecast. The implication is that forward contracts should not be expected to contain property exposure and should be used only in conjunction with the preceding contracts.

- In our case, we know the starting index level for the Calendar 2013 contract. Our sole problem is that it refers to Dec 31, 2012 which is a point in time 3 months ago. Since we are buying the exposure on March 31, it is only fair to pay the seller for the accrued property returns over those three months. These returns have two components, income and capital.
    - Income should be relatively straightforward to estimate based on extrapolation from the most recent Estimates of Annual Index. In our example, it will likely be about 1.47%.
    - Capital value is more difficult to judge. We not only need to know where the IPD capital index will eventually be published for March 31, but we also need to know what premium/discount property is trading at versus the IPD. The reason is because that premium/discount is present today on March 31, and will eventually be picked up by the IPD Index. Since we know this property capital rise/fall has already happened, it must be in the futures price. Judging what the premium/discount is for this "lag" is the most difficult part of pricing the futures, as it is for pricing a physical property portfolio. In our example, let's say that the IPD will publish capital declines of -0.75 in the March index estimate, and we believe there is a further 1% discount in property prices to that index level. Thus, the total capital adjustment will be -1.75%.
    - Income + Capital = +1.47 – 1.75% = -0.28% return adjustment from year end to today.

But how can we adjust the starting index level by our -0.28%? Quite simply there is no way to adjust the starting and ending IPD levels, so we make the adjustment in the Fixed Rate, which is the only variable we can adjust. The Calendar 2014 and all future years are much easier to price as they require no adjustment.

Our new Fixed Rates are now:
Calendar 2013 Fixed Rate = 1% interest x (0.75 years March to Dec) – 0.28% index adjustment = 0.47%.
Calendar 2014 Fixed Rate = 1% interest x 1 year = 1.0%.

The theoretical futures prices are then 100.47 for the Calendar 2013, and 101.00 for the Calendar 2014.

The caveats:

What exactly does "theoretical" mean? It reflects the futures price at which one would earn the same risk and returns as an investment in a physical IPD like portfolio, excluding transaction costs. The futures market may or may not be priced there, but it's important to know the theoretical price as a reference price to which one adds one's own unique circumstances.

In practice, there are real differences between the property futures and direct investment. For starters, there are significantly higher transaction costs from both fees and taxes in a physical property investment. In addition, liquidity, speed to market, and the ability to diversify are significantly different. We need to consider how to incorporate those into the derivative prices.

At this stage, we should consider how these differences affect both futures buyers and sellers.

Benefits of Derivatives over Physical Property	**Liquidity**	**Transaction Costs**	**Diversification**
Futures Buyer	Benefit: +0.25%	Benefit: +7.0% amortized	Depends: Benefit to Beta buyers: 0.50% Cost to Alpha seekers: -0.50%
Futures Seller	Benefit: +0.25%	Benefit: +7.0% amortized	Depends: Benefit to Hedgers of Correlated Risk: 0.50% Cost to Hedgers of Specific Risk: -0.50%
Net:	-	-	-

Above is an attempt to quantify the benefit of derivatives to buyers and sellers. The transactional costs are a one time cost and should be amortized over the course of a trade. Because the futures are a roundtrip, to compare apples to apples (or even oranges to oranges), both buyers and sellers of the futures would experience the full transactional costs if they chose to implement their transaction using physical property instead of derivatives.

The table shows that, in general, the benefits apply equally to buyers and sellers. For a (roughly) two year investment horizon such as our example trade, the buyer gets benefits from the derivatives that are worth 4.25% annually (0.25% + 7%/2yrs + 0.50%). In fact the seller has those same benefits. This means that it they trade at the "theoretical" price, the derivatives will have created value to each of 4.25% per year over physical property. If they transact at prices which are 4.25% worse than the theoretical price, then each will have found where they are indifferent between using derivatives and physical property.

To illustrate, by adding those benefits to our theoretical prices, we get indifference prices.

Indifference Price	**Calendar 2013**	**Calendar 2014**
Futures Buyer	104.72 =(100.47 + 4.25)	105.25
Futures Seller	96.22 =(100.47 - 4.25)	96.75
Mid-Market:	100.47	101.00

This table deserves further explanation. Using the derivatives has created so much value that a buyer would be willing to pay significantly more than theoretical, and a seller would be willing to sell at significantly less than theoretical. In practice, they should meet in the middle and extract the value created equitably. If the pricing trends above the theoretical this is a sign that there are more buyers than sellers, and the converse would also be true.

Take note that the mid-market prices are the same as the theoretical prices. The reason is because in our example, the benefits to buyers and sellers are balanced. This does not need to be the case. In our market there are two prominent examples where they are not balanced:

- Property derivatives are the only means available to hedge the property market, while there are many ways to invest in property. Thus, there should be a strong negative bias to pricing, which is seen in other markets.
- Counteracting that, the entire property market is a natural buyer of property. However, because it has not been traditionally possible to hedge property, there is no job description titled "portfolio hedger". Thus, there is a large imbalance of potential buyers versus sellers.

There is one more caveat to note. We mentioned that a series of futures contracts looks like a longer holding period for a property investment. The good news is that when comparing to physical property, transactional costs should only be considered at the start and end of the holding period (2 years in our example), and not once for each year. But the caveat to keep in mind is that because the futures pay the total returns annually, the income and capital gains are not automatically reinvested. In a property, the capital gain simply remains invested in the property, but a future pays that gain out. To compensate, one would need to increase/decrease the futures position annually to reinvest the capital gains/losses.

Calculating the Payout

In our example, assuming:

Investment amount: $100,000,000 (2000 contracts in each of the Calendar 2013 and Calendar 2014)
Prices paid for futures: 100.47 for the Calendar 2013 and 101.00 for the Calendar 2014

After our initial purchase, if the property prices did not change, assume the IPD will have published a total return of 4.25% (6% income -1.75% capital loss) in 2013 (IPD = 1628.42142), then:

$$Futures\ Payout = \left[\left(\frac{IPD\ Index_{Final}}{IPD\ Index_{Start}} - 1\right) - FixedRate\right] x\ £50{,}000\ x\ \#contracts$$

$$Futures\ Payout = \left[\left(\frac{1628.42142}{1562.03493} - 1\right) - 0.47\%\right] x\ £50{,}000\ x\ 2000 = £3{,}780{,}000$$

Or written as Eurex would show:

$$Futures\ Payout = [Settlement\ Price - Purchase\ Price\ ] x\ £50{,}000\ x\ \#contracts$$

$$Futures\ Payout = [104.250\% - 100.470\%\ ] x\ £50{,}000\ x\ 2000 = £3{,}780{,}000$$

Thus, £3,780,000 would be paid on the futures settlement date, March 31, 2014. This is a leveraged investment, but to delever the futures, one should hold the other 84% of investment in a cash account earning interest. Thus, the investment would have earned another 1% on the £100 million of cash for 9 months, which is £750,000, for a portfolio return of 4.53% measured to Dec 31. Checking our answer, since we said that there was no change in property capital values, we should have expected a return of 9 months of income, or 4.5%.

After another year, if IPD returned 6% income + 1% capital in 2014, the futures would pay:

$$Futures\ Payout = \left[\left(\frac{1742.41092}{1628.42142} - 1\right) - 1.00\%\right] x\ £50{,}000\ x\ 2000 = £6{,}000{,}000$$

Or written as Eurex would show:

$$Futures\ Payout = [107.000\% - 101.000\%\ ] x\ £50{,}000\ x\ 2000 = £6{,}000{,}000$$

The £100 million of cash will have earned £1,000,000 at 1% interest for an unleveraged return of 7.00%.

Pricing Summary:

This completes the pricing discussion. You should be comfortable calculating a theoretical price which equates futures to the risk and return of an investment in physical property. Then, you should be able to calculate your own indifference price at which there is no longer a benefit to using derivatives. Your own situation will then dictate where you will be willing to buy/sell.