

AN INVESTIGATION INTO THE HEDGING EFFECTIVENESS OF THE IRISH INTEREST RATE FUTURES MARKET

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Introduction

The economic rationale for the existence of futures markets is that they facilitate hedging: they allow the more risk averse market participants to transfer the risk of price changes to speculators more willing to bear such risks. Recent fluctuations in interest rates and currencies bear testament to the need for such a hedging mechanism. Accordingly, the effectiveness with which such markets facilitate hedging is of considerable interest.

This paper is concerned with the hedging effectiveness of the three interest rate futures contracts traded on the Irish Futures and Options Exchange (IFOX). This exchange commenced operations on 29th May, 1989. Both the 3 month DIBOR Contract and the 20 year Long Gilt Contract have been traded from this date. Due to the volatility of long-term interest rates in recent years, the Long Gilt Future is frequently traded for both speculative and hedging purposes. The DIBOR futures contract has a broader based use, which is reflected in its high trading volume. On September 6th 1990, IFOX launched a future on a notional 5-year Government Gilt and there has been substantial activity in this contract.

Hogan (1990) undertook a preliminary analysis of the hedging effectiveness of IFOX futures contracts. His study is restricted to the September 1989 Long gilt future which traded from 29 May 1989 to 20 September 1989. In this paper we examine the hedging effectiveness of the DIBOR, Long Gilt and Short Gilt futures over a significantly longer time period. Consequently, we can compare the hedging effectiveness of the various IFOX-traded futures. Our much larger sample allows us to examine hedges of different lengths and to observe some of the factors upon which hedging effectiveness is hypothesised to depend. In addition, we undertake a comparative analysis for the corresponding futures traded on the London International Financial Futures Exchange (LIFFE).

In the next section we outline briefly the theory which underlies our methodology. In the third section of the paper we describe the empirical analysis and results pertaining to hedging effectiveness. Section 4 deals with the impact of hedging on portfolio returns. We conclude with a summary of our findings.

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Hedging

Hedging can be defined as taking a position in one asset so as to reduce or eliminate exposure to adverse price movements in another asset. Futures markets facilitate hedging for investors who are long (short) in the spot market by allowing them to sell (buy) related futures contracts. A perfect hedge occurs where the losses on the spot position are exactly offset by gains in the futures market. Such perfect hedges are only possible when one can predict the change in basis (the difference between the futures price and the spot price) with certainty. In practice such perfect hedges are rarely possible because the relationship between futures and spot prices is not deterministic, except to the extent that they will converge at the settlement date of the futures contract if the asset being hedged corresponds exactly to that underlying the futures contract. Futures prices may not track spot prices perfectly because they represent investments at different points in time or deliverable at different locations, or because the investment being hedged may differ significantly from that specified in the futures contract (a cross-hedge). Thus, the basis might change in a manner that is not perfectly predictable if (a) the period of the hedge is such that the futures position is closed out and the hedge lifted before the settlement date of the futures contract or (b) the asset underlying the futures contract does not correspond exactly to that which is being hedged. This implies that the hedger is usually exposed to some risk. The residual risk that exists after hedging is termed basis risk.

The hedging effectiveness of a futures market is defined in terms of the potential for risk reduction. The greater the basis or residual risk to which a hedger is exposed, even after hedging to minimise risk, the less effective the futures contract used for the hedge. Ederington (1979) proposes that the futures market *potential* for risk reduction can be assessed by comparing the risk of an unhedged position [VAR (U)] with the minimum risk that can be obtained on a portfolio consisting of spot and futures investments:

$$e = 1 - \frac{\text{VAR}(R^*)}{\text{VAR}(U)}$$

where VAR(R*) = the variance of a portfolio comprising of the spot position and a futures position calculated so as to minimise risk.

Ederington, using Modern Portfolio Theory (MPT), also shows that the risk minimising hedge ratio (the proportion of the spot position being hedged so as to minimise risk) is equal to the covariance of changes in the spot price with changes in the futures price divided by the variance of the futures price changes, σ_{sf} / σ_f^2 . The estimate of the risk minimising hedge ratio is therefore the slope coefficient (b*) in the following regression

$$S_t - S_{t-1} = a + b^* (F_t - F_{t-1}) + \varepsilon_t$$

where S_t = the spot price of the asset being hedged at time t,
 F_t = the corresponding futures price at time t, and
 ε_t = the error or disturbance term.

The measure of hedging effectiveness 'e' is the percent reduction in the variance. Ederington shows that this 'e' is simply:

$$e = \frac{\sigma_{sf}^2}{\sigma_s^2 \sigma_f^2} = \rho^2$$

Therefore, the estimated measure of hedging effectiveness is the sample coefficient of determination, R^2 , associated with the second equation above. It reflects the maximum risk reduction which is possible by trading a particular futures contract in conjunction with a given spot position.

We use the methodology of Ederington here. This allows us to examine a number of hypotheses regarding the variables on which hedging effectiveness is purported to depend. Ederington argues that hedging effectiveness increases with the length of the hedge. Futures prices have more time to respond to spot price changes over longer periods, so price change correlations would be expected to be higher for 4-week than for 2-week intervals. He also posits that hedging using "nearby" futures contracts is more effective than using more distant contracts. Work on adaptive expectations supports the view that one's expectations of the near future are likely to be affected more by unanticipated changes in the spot price than one's expectations of the more distant futures. Figlewski (1986), on the other hand, argues that hedging effectiveness will increase with the time to maturity of the futures contract. Ederington's empirical analysis and that of Hill and Schneeweis (1980), for interest rate futures, suggest that hedging effectiveness will decrease with time to maturity. It has also been suggested (Figlewski) that the greater the liquidity of the futures market the more effective it will be for hedging. The above arguments would lead us to expect that LIFFE would be more effective than IFOX, that nearby contracts would be more effective than longer to maturity contracts and that the DIBOR futures would be the most effective and Short Gilt futures the least effective hedging instruments in the Irish market.

Alternative Hedging Methods

A number of alternative approaches to calculating hedge ratios are documented in the literature relating to hedging interest rate associated price change risk. These methods include the Value Match, Conversion Factor, Regression of Price Levels, Portfolio Immunization, Price Sensitivity and Instantaneous Price Sensitivity Techniques.

The *OLS Regression of Price Changes Approach* proposed by Ederington (1979) and extended by Franckle (1980) and Figlewski (1986) is a straight-forward technique which also has several advantages over alternative methods. A feature of this approach is that it adjusts *implicitly* for characteristics of the cash market instrument being hedged (coupon and maturity effects) and the futures contract (marking to market). More importantly, it *implicitly* adjusts for less than perfect correlation between spot price and futures price changes i.e. basis risk.

Figlewski (1986) remarks that methods for calculating hedge ratios other than the linear regression of price changes approach, must take account *explicitly* of basis risk, and that many approaches adjust only approximately or ignore basis risk altogether. Applying a strategy with no adjustment for basis risk will probably result in an over-hedged position with a resultant reduction in hedge effectiveness and performance (higher than optimal risk, with lower than optimal returns).

Applying hedging techniques that may be sub-optimal in terms of minimising risk would confound the present analysis. Therefore, we choose to use the OLS approach which gives a theoretically correct measure of the potential for risk reduction provided by a futures market.

Sutcliffe (1993) points out that the OLS regression approach is used to estimate risk-minimizing hedge ratios *only* because the slope coefficient is equal to σ_{sf} / σ_f^2 . Such regressions may be subject to econometric problems. However, the use of more sophisticated econometric techniques¹ to solve these problems will usually *not* provide estimates of σ_{sf} / σ_f^2 . Sutcliffe's observation regarding risk-minimizing hedge ratios is also applicable to the R^2 or estimate of hedging effectiveness. The major econometric problem that we encountered with our OLS regressions was that of autocorrelated residuals. Autocorrelation will not bias the estimated hedge ratios but will render the OLS estimates inefficient. More importantly, from the perspective of the current study, the standard errors of the coefficients and the R^2 will be biased if the regressor is serially correlated also. For hedges in which autocorrelation was a problem, the first order autocorrelation coefficient was estimated and this estimate was used to transform the model so that the new error term had no autocorrelation (see Doran, 1989, p. 205). However, the regression R^2 of the transformed model is not an estimate of the measure of hedging effectiveness. Therefore, in the presence of autocorrelation, the potential risk reduction of a futures contract was estimated by using the revised estimate of b^* to compute $VAR(R^*)$, and then inserting this estimate of $VAR(R^*)$ into the first equation given. Our results are qualitatively the same regardless of whether we adjust for autocorrelation or not. In those regressions that require some adjustment for autocorrelation we find that 'e', when measured as described above, is generally equal to the R^2 of the original model. When e is different from R^2 it is below the original estimate as often as it is above. In the interests of clarity we report only the measures of hedging effectiveness for the adjusted regressions, where such correction was necessary to purge the residuals of autocorrelation.

Empirical Analysis

The data required for this research project for the period 7 July 1989 to 31 December 1991 were as follows:

- Daily Closing Futures Prices from the Irish Futures and Options Exchange (IFOX) for the following contracts:
 - Long Gilt Future Contract,
 - Short Gilt Future Contract,
 - 3-month DIBOR Future Contract.
- A series of Daily Closing Futures Prices from the London International Financial Futures Exchange (LIFFE) for the following contracts:
 - Long Gilt Futures Contract,
 - 3-month LIBOR Futures Contract².
- Series of Daily Closing Prices for the following Irish cash gilts:
 - 8.5% Capital, redeemable 1/10/2010,
 - 8.75% Capital, redeemable 30/09/2012,
 - 9% Capital, redeemable 30/07/1996³.
- Series of Daily Closing Prices for the following UK gilts:
 - 9% Treasury, redeemable 2008,
 - 8% Treasury, redeemable 2009.
- Series of Daily Closing Rates for the DIBOR (3 month) and the LIBOR (3 month).

The IFOX and LIFFE futures prices were obtained on diskette from the respective Exchanges while the spot price data was obtained from DATASTREAM. This data was used to generate time-series of price changes. Splice points were then omitted from the data sets.

Direct Hedging in the Irish and UK Future Markets

Details of the hedges examined are as follows:

I *Interbank Offered Rate Futures*

- An IFOX DIBOR futures hedge, where the cash position involves undertaking to deposit IR£100,000 at a particular DIBOR rate for 3 months,
- A hedge in the LIFFE LIBOR futures contract was also examined, where the cash position is a deposit of stg£100,000 at a particular LIBOR 3-month rate.

II *Long Gilt Futures*

- Hedging Irish long-dated government bonds (the 8.5%, 2010 and the 8.75%, 2012), using the IFOX Long Gilt futures.
- Hedges in the LIFFE Long Gilt futures contracts of UK long-dated Treasury bonds (the 8%, 2009 and the 9%, 2008) were also examined.

III *Short Gilt Futures*

- A hedge of an Irish short-dated stock (the 9%, 1996), using the IFOX Short Gilt futures contract.
- A cross-hedge of the same Irish short-dated government stock using the IFOX Long Gilt contract was also examined. A comparison of this cross-hedge with the direct Short Gilt futures hedge allows us to evaluate the incremental benefit in terms of hedging effectiveness, that accrued from the introduction of the Short Gilt future.

Weekly, 2-weekly and 4-weekly hedges were considered in this analysis. Furthermore, because hedgers can invest in futures contracts with near or distant delivery dates, the nearby contract, the 3-6 month and the 6-9 month contracts were separately considered.

I *INTERBANK OFFERED RATE FUTURES*

Table 1: Interbank Rate Futures

	DIBOR			LIBOR		
	Panel A: Nearby					
	<i>b</i> *	<i>e</i>	<i>DW</i>	<i>b</i> *	<i>e</i>	<i>DW</i>
1 week	.79 (.05)	.51	2.19	.88 (.06)	.72	2.07
2 week	.93 (.06)	.76	1.9	.86 (.08)	.73	2.03
4 week	1.02 (.07)	.93	2.17	.94 (.09)	.79	1.94
	Panel B: 3 - 6 Month					
1 week	.67 (.05)	.48	2.11	.61 (.06)	.52	2.12
2 week	.78 (.07)	.68	1.96	.65 (.09)	.60	2.07
4 week	.80 (.07)	.87	2.01	.64 (.06)	.55	2.13
	Panel C: 6 - 9 Month					
1 week	.63 (.06)	.41	2.17	.56 (.07)	.42	2.04
2 week	.75 (.07)	.66	1.93	.63 (.11)	.50	2.03
4 week	.80 (.08)	.88	2.05	.58 (.12)	.43	2.17

e = estimate of measure of hedging effectiveness.
Standard errors are in parentheses.

Ederington (1979) hypothesised that hedging effectiveness would be greater for longer hedges vis-a-vis shorter hedges because futures prices have more time to respond to spot price changes over longer periods, so price change correlations would be expected to be higher for 4-week than for 2-week intervals. The results outlined in Table 1 indicate that hedging effectiveness of the IFOX futures is increasing in hedge length. The measure of hedging effectiveness for 4-week hedges using the nearby DIBOR contract is 93.0% compared with just 51.0% for a weekly hedge. A similar pattern is evident for hedges in more distant contracts. Ederington further hypothesised that hedging effectiveness would be greater (less) for hedges in nearer (more distant) futures contracts - this hypothesis is largely supported in Table I. Hedging effectiveness is greater for hedges in the nearby futures relative to hedges in the 3-6 month distant contract and, the hedging effectiveness of these, in turn, is generally superior to that of the 6-9 month contracts. It can be seen from Table I that observed minimum variance hedge ratios are generally less than one, so that Modern Portfolio Theory more accurately reflects the method by which hedge ratios should be determined than Traditional Theory which assumes a hedge ratio of one. T-statistics, which test the following hypotheses,

H (0) : b^* equal to one

H (1) : b^* not equal to one

indicate that in all cases, the observed hedge ratio is significantly different from one at the 5% level. Therefore, use of the Traditional Theory would not have yielded even a reasonable approximation to the appropriate hedge ratio over the sample period, for these hedges. The results support and justify use of the Portfolio approach to hedge ratio determination.

The London International Financial Futures Exchange (LIFFE) has been in operation since 1982, and has been characterised by considerable trading activity in the interim. Consequently, it was decided to undertake an analysis of hedging effectiveness for the LIFFE traded futures, for comparative purposes. Summary statistics for the LIBOR (LIFFE) hedges are also reported in Table I.

One would expect hedging effectiveness to be greater for the LIFFE contracts than for the IFOX contracts because liquidity is greater in the London futures market. With the exception of weekly hedges, the DIBOR hedges consistently outperform the LIBOR hedges in terms of hedging effectiveness. For all hedges except the one-week hedge in the nearby contract, estimates of the minimum variance hedge ratio are also greater for the DIBOR hedges. A hedge with a higher measure of hedging effectiveness but a lower associated minimum variance hedge ratio is more efficient than a hedge with lower effectiveness for a higher hedge ratio, because transactions costs increase with the hedge ratio and risk-reduction increases as 'e' rises. However, this pattern was not in evidence in the table of comparative results so no inference as to the *relative efficiency*

of the various hedges can be made. While measures of hedging effectiveness for both the LIBOR and DIBOR hedges are good, on balance the DIBOR futures appear to be superior for hedging purposes. One possible explanation is that the LIBOR futures are used to hedge and speculate on a wider variety of spot positions than the DIBOR. As a consequence, futures prices may move less closely with the underlying spot position than is the case for the Irish spot-futures price relationship. It may be that this lower covariance and resultant lower hedging effectiveness is the penalty which must be paid for greater market liquidity.

II LONG GILT FUTURES

The IFOX Long Gilt future is based on £50,000 nominal of a notional 8%, 20 year Irish Government stock. There are a number of long-dated gilts listed by the Exchange as deliverable against the IFOX Long Gilt future. We chose to examine the performance of the IFOX Long Gilt future in hedging the 8.5% (2010) and the 8.75% (2012). Due to illiquidity in the Irish market, the Long Gilt futures are not traded beyond the 3-6 month distant contract. Even this contract was characterised by thin-trading in some of the sample sub-periods, so that insufficient data was available to make a full comparison of IFOX futures hedges with LIFFE hedges. The comparison is limited to weekly hedges for the 3-6 month contract.

Table 2: IFOX Long Gilt Hedges

	8.5%, 2010			8.75%, 2012		
	Panel A: Nearby					
	<i>b</i> *	<i>e</i>	<i>DW</i>	<i>b</i> *	<i>e</i>	<i>DW</i>
1 week	.995 (.023)	.877	2.30	1.03 (.026)	.868	2.46
2 week	.996 (.02)	.967	2.14	1.04 (.02)	.967	2.35
4 week	.995 (.04)	.98	1.98	1.07 (.039)	.985	2.04
	Panel B: 3 - 6 Month					
1 week	1.15 (.04)	.837	1.81	—	—	—
2 week	—	—	—	—	—	—
4 week	—	—	—	—	—	—

e = estimate of measure of hedging effectiveness.
Standard errors are in parentheses.

It appears that hedging effectiveness is increasing in hedge length, and is greater for hedges in nearer-to-maturity contracts, although firm conclusions cannot be drawn in regard to this latter relationship, due to limitations in the data set. For all hedges using the Long Gilt future, estimates of the minimum variance hedge ratio are not significantly different from one at the 5% level, so that Traditional Hedging Theory ($b^*=1$) would have provided a very reasonable approximation to the appropriate hedge ratio for any of these hedges. This however is not inconsistent with use of Modern Portfolio Theory, which will yield a hedge ratio close to unity if the correlation between spot and future price changes is close to 1. This is the case for hedges of these long-dated gilts using the IFOX Long Gilt futures contracts.

An interesting point to note about the IFOX contracts is that hedging effectiveness is greater for the Long Gilt futures than for the short-term DIBOR futures despite the greater liquidity of the DIBOR contracts, and this finding is consistent for all hedge lengths. A possible explanation lies in the spot position which is being hedged using the futures. The DIBOR future may be used to hedge a variety of spot positions, while the Long Gilt future is likely to be traded to hedge a position in gilts of similar coupon and maturity to the underlying security to the futures contract. This factor may be responsible for the relatively greater correlation between spot and futures price changes for the Long Gilt hedges vis-a-vis the DIBOR hedges.

The LIFFE Long Gilt future is based on £50,000 nominal of a notional 9% 20 year UK Treasury stock. Two long-dated UK Treasuries which are deliverable against the LIFFE Long Gilt future, the 8% (2009) and the 9% (2008), were investigated for the purposes of comparison with IFOX hedges of Irish Government stocks. Because hedging effectiveness was very similar for both of these gilts, only summary statistics for hedges of the UK 9% 2008 Treasury are reported. Price change correlations between the 9% 2008 stock and all three Long Gilt futures contracts were high so hedging effectiveness was impressive. For approximately two thirds of all hedges examined, the observed ' b^* ' was insignificantly different from one, reflecting the close price change relationship. Measures of relative hedging effectiveness and estimates of minimum variance hedge ratios for the LIFFE and IFOX Long Gilt futures hedges are reported in Table III.

Hedging effectiveness of LIFFE and IFOX is very similar for all hedges studied. The highest observed measure of hedging effectiveness, $e = 98.0\%$, pertains to the 4-weekly hedge of the Irish 8.75% gilt in the nearby futures contract. Estimates of the minimum variance hedge ratio are close to unity for all hedges, to the extent that a hedge ratio of one would have provided an extremely good approximation to the appropriate hedge ratio for any Long Gilt hedge. Overall hedging effectiveness is impressive for both IFOX and LIFFE hedges.

Table 3: Long Gilt Futures

	IFOX (8.5%, 2010)			LIFFE (9%, 2008)		
	Panel A: Nearby					
	<i>b</i> *	<i>e</i>	<i>DW</i>	<i>b</i> *	<i>e</i>	<i>DW</i>
1 week	.995 (.026)	.877	2.30	1.01 (.025)	.918	2.12
2 week	.996 (.02)	.967	2.14	1.01 (.035)	.95	2.00
4 week	.995 (.04)	.98	1.98	1.02 (.054)	.94	2.33
	Panel B: 3 - 6 Month					
1 week	1.15 (.04)	.837	1.81	.93 (.03)	.90	1.98
2 week	—	—	—	.91 (.04)	.915	2.14
4 week	—	—	—	1.03 (.077)	.90	2.07
	Panel C: 6 - 9 Month					
1 week	—	—	—	1.02 (.06)	.88	1.54
2 week	—	—	—	.80 (.1)	.915	1.95
4 week	—	—	—	.76 (.14)	.907	1.76

e = estimate of measure of hedging effectiveness.
Standard errors are in parentheses.

III SHORT GILT FUTURES

On 6th September 1990, IFOX launched a Short Gilt Future, which is based on £100,000 nominal of a notional 8% 5-year Irish Government Gilt. Previous to this date, Irish investors holding a spot position in short-dated Irish stock, who wished to use futures to hedge their investment against interest rate associated price change risk, would have had no option but to hedge using either the DIBOR or Long Gilt futures. Because the DIBOR rate reflects changes in and expectations of *short-term* interest rates, it is deemed more likely that investors wishing to hedge an investment in a government gilt would hedge in the Long Gilt future, rather than in the DIBOR. The effectiveness of the latter future to hedge a position in the Irish 9% Capital Stock, maturing in 1996 was, as expected, considerably inferior to measures using the Long Gilt future. Thus, we restrict our comparative analysis to the Long and Short gilt futures.

If measures of hedging effectiveness were superior for the Short Gilt future over the period studied, one would conclude that IFOX was justified in launching the new contract, and that the introduction has enhanced the quality of instrument available to Irish market participants for managing financial risk. Table IV contains comparative statistics for a direct-hedge of the Irish 9% (1996) gilt using the Short Gilt future and for a cross-hedge of the same gilt using the Long Gilt future.

Table 4: Direct and Cross Hedges of Short Gilt

	Short Gilt Future			Long Gilt Future		
	Panel A: Nearby					
	<i>b</i> *	<i>e</i>	<i>DW</i>	<i>b</i> *	<i>e</i>	<i>DW</i>
1 week	1.03 (.056)	.843	1.98	.456 (.031)	.655	2.02
2 week	1.06 (.087)	.83	2.24	.474 (.038)	.706	2.01
4 week	1.29 (.094)	.91	1.84	.503 (.053)	.821	1.97
	Panel B: 3 - 6 Month					
1 week	.717 (.13)	.623	2.28	—	—	—
2 week	.814 (.25)	.602	2.11	—	—	—
4 week	.776 (.093)	.743	2.7	—	—	—

e = estimate of measure of hedging effectiveness.
Standard errors are in parentheses.

The results for the direct hedge of the 9% 1996 gilt, reported on the left hand side of table IV, indicate that considerably greater risk reduction is possible by using the Short Gilt future for hedging purposes. The measure of hedging effectiveness for a 1-week direct-hedge in the nearby contract is 84% and rises to 91% for a 4-week (direct) hedge. In comparison, a cross-hedge using the Long Gilt future had lower overall risk reduction over the same period; hedging effectiveness was 65% and 82% for a 1-week and 4-week hedge respectively. It is noteworthy also, that in all cases the estimate of the minimum variance hedge ratio is considerably higher for the direct-hedges than for the corresponding cross-hedges. In many cases the estimate for the cross-hedge is less than half that for the direct-hedge. This is because there is a closer match of coupon and maturity effects of the spot instrument being hedged with those of the Short Gilt future, than with those of the Long Gilt future.

In summary, while a good hedge would have been possible using the Long Gilt futures over the sample period, hedging effectiveness was considerably superior for direct-hedges using the newly instituted Short Gilt futures. Therefore, the introduction of the IFOX Short Gilt future has enhanced hedging possibilities at the short end of the market.

The Cost of Hedging

The essence of hedging with financial futures is that the futures position taken is combined with the existing cash market holdings to result in a desired net exposure to risk on the overall portfolio. Ideally investors desire to minimise risk and to maximise returns. Futures markets allow hedgers and speculators to alter both, but not independently. Hedging is generally costly in that risk can only be reduced in conjunction with a reduction in expected return. Ederington (1979) noted that the expected basis movement has an impact on the returns to a hedged position. In particular, if there is reason to believe that futures prices will be consistently lower (higher) than spot prices, so that a positive (negative) change in the basis can be expected, short-hedgers can anticipate a reduction (increase) in the returns to the overall portfolio⁴.

This impact of hedging on expected returns was investigated for 4-week direct-hedges in the DIBOR, LIBOR, IFOX Long Gilt, LIFFE Long Gilt and IFOX Short Gilt futures, and for the cross-hedge of the Irish short-dated gilt using the IFOX Long Gilt future. Changes in the basis were generally positive for the sample period, subtracting marginally from the return for short hedges and adding marginally to the return for long hedges. The average basis change was negative for most of the Interbank Offered Rate futures, and this would have added to the expected return of the short-hedged position over the sample period. However, in no case was the average change in the basis significantly different from zero at any of the conventional significance levels. With respect to the issue of an inverse relationship between the average change in the basis and the time to maturity of futures contracts, no clear pattern was observed. Therefore, no firm recommendations as to the merits of hedging in nearer-to-maturity or more distant futures contracts can be made, in the context of optimising the effects of hedging on expected returns.

Conclusions

This paper has investigated the effectiveness of the IFOX futures contracts in hedging spot positions in a variety of maturities of IR£ denominated fixed interest investments. We also examine the effectiveness of the LIFFE futures contracts to hedge spot positions in a variety of maturities of sterling denominated fixed interest investments. The cross-hedging effectiveness of the IFOX Long Gilt futures contracts to hedge a spot position in a short-dated Irish Government gilt was also studied. The paper includes an examination of the basis relationship over the sample period, and any implications of this relationship for the cost of hedging in futures contracts. The study findings may be

summarised as follows:

- The hypotheses that hedging effectiveness increases for hedges in nearer to maturity contracts, and for longer (4-week) hedges, are supported in this analysis.
- Measures of hedging effectiveness for longer hedges in particular, are impressive for most direct-hedges investigated. Only one measure of hedging effectiveness for an IFOX 4-week hedge is below 80%, for the sample period.
- Both the IFOX and LIFFE Long Gilt futures outperform the DIBOR and LIBOR futures contracts in terms of hedging effectiveness despite the greater liquidity of these short maturity futures. This finding is contrary to the Figlewski (1986) hypothesis that hedging effectiveness increases with market liquidity.
- The Modern Portfolio Theory (MPT) approach to determining minimum variance hedge ratios appears to be superior to the Traditional Hedging Theory (THT) approach for hedges using the short-maturity futures (DIBOR and LIBOR). For hedges in these contracts, the observed minimum variance hedge ratio was significantly different from one. However, for the Long Gilt futures, the THT hedge ratio of one would be a very good approximation to the appropriate hedge ratio.
- Although a reasonably good cross-hedge could have been achieved using the Long Gilt future over the period of this study, the IFOX Short Gilt futures contracts have considerably improved the possibilities for risk-reduction on holdings of short-dated Irish Government Gilts, since their introduction in September 1990.
- The observed average change in the basis over the sample period was insignificantly different from zero, so that aside from transactions costs, there was no significant cost associated with short-hedging.
- On balance, the IFOX long gilt futures contracts were more effective than the LIFFE contracts at hedging long spot positions in fixed income securities. Taken in conjunction with the third point above, it may be that the relationship between liquidity and hedging effectiveness is non-monotonic. While a positive relationship is intuitive, it may well be that some factors that increase liquidity can cause hedging effectiveness to decline.

The results of this study point conclusively to the effectiveness of the IFOX-traded interest rate futures contracts for hedging a variety of different maturity cash positions. In particular, the introduction of the IFOX Short Gilt future in September 1990 has greatly enhanced the possibilities for hedging interest rate associated price change risk on the short-dated gilts trading in the Irish market. Direct-hedges using IFOX or LIFFE futures contracts are broadly speaking comparable as regards hedging effectiveness. Thus, our overall results indicate that IFOX has added significantly to the quality of instrument available to Irish market participants for interest rate risk management.

Notes

1. Kenneally and Cronin (1994) is a good example of a sophisticated econometric approach to the estimation of hedge ratios.
2. There is no Short Gilt Futures Contract traded on the London Exchange.
3. The period over which price data for the Short Gilt Futures Contract was collected was 5th October 1990 to 31st December 1991. This contract actually commenced trading on 6th September 1990, but in order to allow the market gain some depth, prices were collected for a period commencing approximately one month after initial trading. For comparative purposes, price data for the 9% 1996 gilt which is deliverable against the Short Gilt Futures Contract, was collected for the same period.
4. If spot prices exceed futures prices, the futures price will increase as contract maturity approaches to fulfil the Convergence Property, so the long position to the futures contract gains from the upward movement in the futures price. Conversely the short position suffers a loss, which translates into a reduction in overall expected returns - a cost to hedging.

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