WHY DO THE LIFFE AND DTB BUND FUTURES CONTRACTS TRADE AT DIFFERENT PRICES?

Francis Breedon
Bank of England

Any views expressed are those of the author and not necessarily those of the Bank of England. I would like to thank Rachel Charlton, Neil Cooper, Jo Corkish, Alison Howett, John Tutt and E. Tim Sahlin for their help. Any errors and omissions are of course my own.

Issued by the Bank of England, London, EC2R 8AH to which requests for individual copies should be addressed: envelopes should be marked for the attention of the Publications Group. (Telephone: 0171 601 4030)

Bank of England 1996 - ISSN 0142-6753

Contents

Abstract

Bund futures are traded in both London (LIFFE) and Frankfurt (DTB) on open outcry and electronic trading platform respectively. One oddity in this market that has attracted much practitioner comment is that the LIFFE contract has traded slightly more expensively - about 1.5 basis points - than the DTB one despite an almost identical specification. This paper explores a number of possible explanations for this phenomenon but finds that none are important enough to explain the observed price difference.

I. INTRODUCTION

The German Bund futures contract is the most heavily traded bond contract outside the US. It is unusual in that it trades on two markets (LIFFE in London and DTB in Frankfurt) with no apparent tendency for one market to drive out the other. One feature of these dually traded contracts that has been the focus of practitioner interest for some time is the fact the LIFFE contract trades slightly more expensive than the DTB one despite being for delivery of the same bonds at the same time. This paper investigates some possible reasons for the price difference but finds that none of the explanations that have been put forward are capable of explaining the observed difference.

II. THE BUND CONTRACT

The Bund future traded on both LIFFE and the DTB is an agreement that the short will deliver DM250,000 face value of German Government bonds (including Federal government, Unity fund and Treuhand) to the long on the specified delivery day[1] (the 10th day of the delivery month. Contracts for March, June, September and December delivery are traded) in return for a specified price. Like all bond futures, the bond specified for delivery in the Bund contract is simply a notional bond (i.e. does not exist) which in this case is specified to have a 6% coupon. Actual delivery can be undertaken with a range of bonds called the basket of deliverables. All German government bonds in the maturity range 8.5 to 10 years qualify for this basket and so the short can deliver any of these qualifying bonds. Of course, these qualifying bonds will trade at very different prices and so the Exchange applies a set of price factors (i.e. multipliers applied to the delivery formula which mean that a greater number of relatively cheap bonds must be delivered. These are discussed in more details below) to help make the basket comparable. However, these price factors do not eliminate all price differences and so for any given contract there will be one bond in the basket that will be the cheapest to deliver (CTD), since the short chooses which bond to deliver, the CTD is the most likely bond to be delivered.

The history of the Bund Contract

The Bund contract was first traded at LIFFE in 1988 and the DTB contract did not begin trading until January 1991 after German legislation prohibiting futures trading was rescinded. The DTB's share of the market increased steadily from 7% share of the front month contract at the beginning of 1991 to average a 26% share for the whole of 1991.

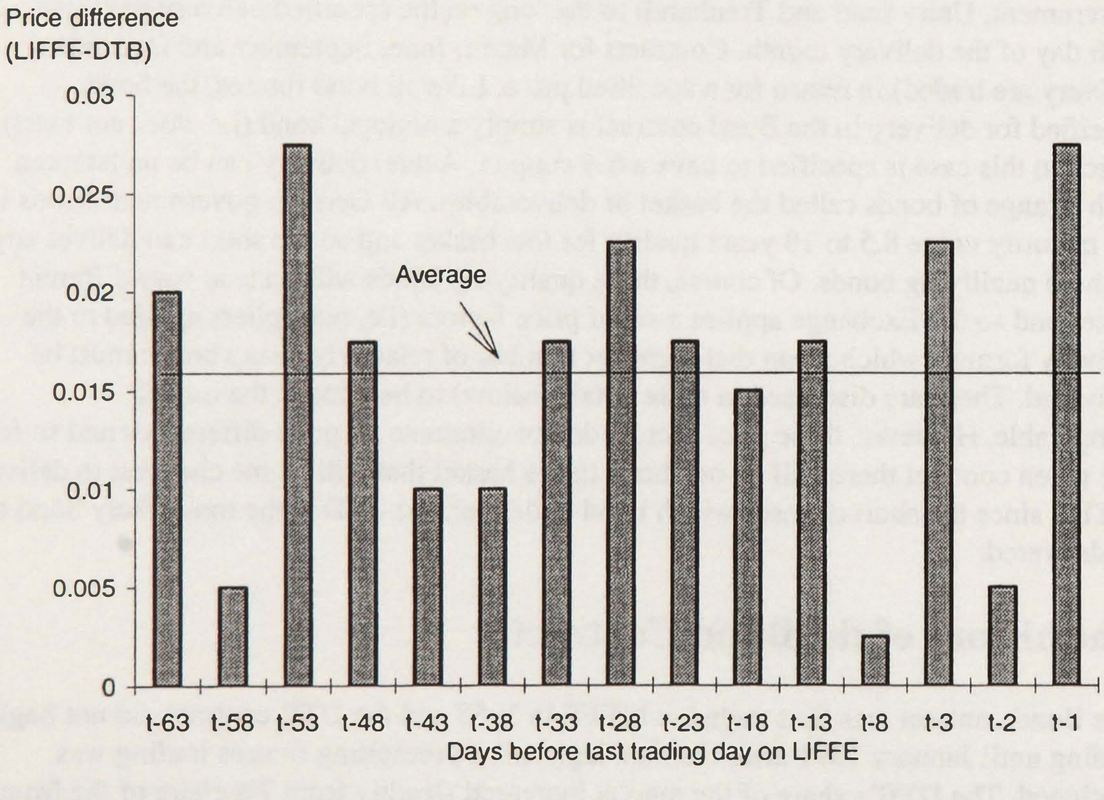
---

(1) The Bund contract differs from some other bond contracts like the US Treasury bond contract which allow delivery on any day in the delivery month.

Between October 1991 and January 1992, the German banks launched a concerted effort to increase trading volume in Frankfurt causing DTB's market share to rise over 50% on some days. However, after this effort ended, DTB share settled back to about 30% where it has remained ever since. There have been a number of studies comparing price formation and liquidity in the two markets (see for example, Pirrong (1994), Shyy and Lee (1995), Franke and Hess (1995), Kofman and Moser (1996), and Breedon and Holland (1996)) which, despite finding contradictory results for relative liquidity and price formation (see Breedon and Holland (1996) for details), all find that the two markets are closely linked. This makes the small but persistent price difference between the two contracts analysed below all the more surprising.

III. PRICE DIFFERENCES BETWEEN CONTRACTS

Chart 1: Price differences between the LIFFE and DTB contracts

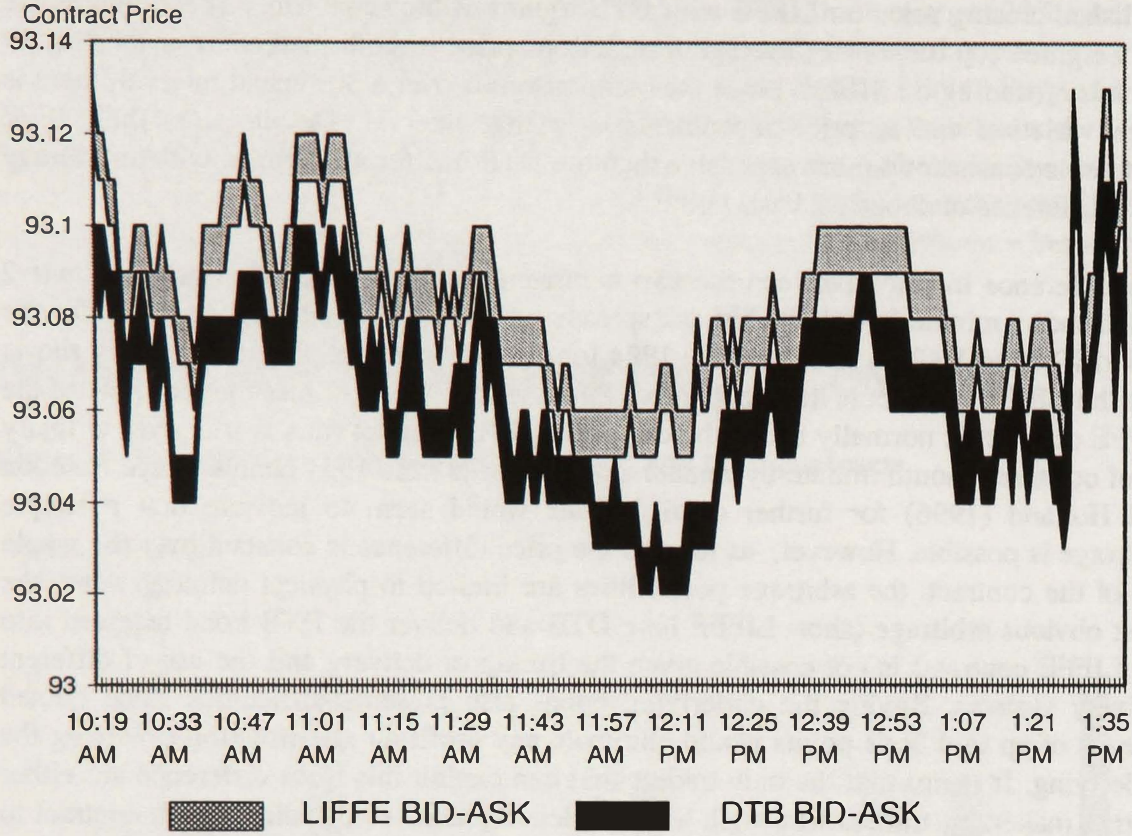


Notes: Average price difference between LIFFE closing prices and DTB price calculated at the same London time for the four contracts between June 1994 and March 1995

Chart 1 shows the average price difference between the two Bund contracts at market close each day for the four contracts between June 1994 and March 1995. It compares the published closing price on LIFFE with DTB figures at the same time. These figures are the weighted (by trade size) average transactions price in both markets over the last 30 seconds of trading on LIFFE. Since the comparison is over a 30 second interval, there is some variation due to price movements over that interval. Despite this, the LIFFE contract is consistently more expensive than the DTB one for all periods, with an average price difference of about 1.5 basis points.

The difference in price between the two contracts can be seen more clearly in chart 2 which shows minute-by-minute bid-ask spreads for the LIFFE and DTB contracts for the period 10:15 to 1:40 on the 28th May 1994 for the June contract. Chart 2 not only shows that the LIFFE contract is more expensive than the DTB one but that the bid price of the LIFFE contract is normally above the ask of the DTB contract (this is true over virtually all of our three month minute-by-minute dataset for the June 1994 contract - see Breedon and Holland (1996) for further details). This would seem to indicate that a simple arbitrage is possible. However, as long as the price difference is constant over the whole life of the contract, the arbitrage possibilities are limited to physical delivery. Also, the most obvious arbitrage (short LIFFE long DTB and deliver the DTB bond received into the LIFFE contract) is not possible given the timing of delivery and the use of different delivery systems. Buying the underlying bonds also presents difficulties since quoted spreads of up to 4 basis points would eliminate any profit on a transaction involving the underlying. It seems that the only traders that can exploit this price difference are either market makers or traders who wish to go to delivery and are deciding which contract to buy. However, the number of contracts that go to delivery is tiny (less than 1% of those traded) and so this group of investors may not exert much influence on the market.

Chart 2: LIFFE and DTB quoted bid-ask spreads



Notes: quoted prices from Reuters for the June 1995 contract on 28/4/95 from 10:20am to 1:40pm London time

Although the narrower spreads on LIFFE may make it a more attractive market than the DTB, it is not clear that they should influence the relative price of the two contracts, other than within the bid-ask spread. Discussions with market practitioners revealed that they felt that the three contract differences were the most likely explanation of the price difference - these are differences in price factors, short term quality options and late delivery penalties.

Price Factors

The use of a basket of deliverables means that some bonds in the basket will be far cheaper/expensive (due to coupon or maturity differences) than the notional bond on which the contract is written. In order to make the contract for bonds in the basket of deliverables similar to contract on the notional bond for which the future is specified, the exchange applies a price or conversion factor to each bond. These specify how much more or less of a given deliverable bond should be delivered to make the value similar to that of the notional bond.

Price factors for the Bund contract are calculated using the following formula

$$P = \frac{\frac{1}{1.06^f}\left[\frac{c}{0.06}\left\{1.06 - \frac{1}{1.06^n}\right\} + \frac{100}{1.06^n}\right] - c(1-f)}{100} \qquad (1)$$

n = number of whole years from the next coupon date to the maturity date

f = number of whole months from the tenth day of the delivery month up to and including the next coupon date, divided by 12

c = annual coupon

Although this basic formula is used to calculate price factors for both the DTB and LIFFE contracts, there is one small difference that can lead to differences in the calculated price factors which relates to the treatment of weekends. On the DTB contract, if the tenth day of the delivery month falls on a non-business day, the calculation in equation (1) is evaluated using the next business day. LIFFE, on the other hand, always uses the tenth day for the purposes of calculation regardless of when it falls. In practice, this means that if delivery day falls on, say, a Saturday, then LIFFE price factors are calculated using the 10th as the delivery day whilst DTB uses the 12th. For Bunds whose coupons are due on, say, the 11th of the month, the number of whole months between the coupon and delivery (f) will differ for DTB and LIFFE

Clearly these differences in price factors could be important in practice, but - as Table 1 shows - the number of occasions on which the price factors differed is quite limited (though for the December 1994 contract, this difference in calculation method meant that one bund was eligible for the basket of LIFFE deliverables but not the DTB) and on no occasion in our sample was the bond with different price factors also the cheapest to deliver (CTD).

Table 1: A comparison of LIFFE and DTB price factors March 1994 to June 1995

Contract	Bonds with different price factors	LIFFE Price Factor for that bond	DTB Price Factor for that bond
March 1994 (12 deliverables)	none	n/a	n/a
June 1994 (11 deliverables)	none	n/a	n/a
September 1994 (10 deliverables)	6.875% 2003 Treuhand	1.057874	1.057378
December 1994 (9/10 deliverables)	6.75% 2004 6.875%2003 Treuhand	1.109556 1.056462	1.108737 n/a
March 1995 (8 deliverables)	none	n/a	n/a
June 1995 (7 deliverables)	6.75% 2004	1.105043	1.104385

Notes: Column one shows the date + number of deliverables for each contract. Column 2 gives a list of bonds for each contract with different price factors in LIFFE and DTB. Columns 3 and 4 show the LIFFE and DTB price factors respectively for that bond

Last Trading Day

One important difference between the LIFFE and DTB bund contracts is the fact that, although the delivery day is the same for both contracts, the DTB contract keeps trading one day longer (the last trading day is usually the 8th rather than the 7th of the delivery month). This extra day could decrease the value of the DTB contract since it gives a one day quality option to the short. The quality option arises because the short need not commit herself to deliver a given bond in the basket until the delivery process begins (after the last trading day). As a result, she has the option to deliver a bond other than the bond that was the CTD at the time she entered the contract should that be to her advantage (i.e. should the CTD change in the interim). This option reduces the face value of the futures contract by the value of this (and other[2]) options since it is the short who acquires these options. Is it this one day quality option that explains the difference between the DTB and LIFFE futures price?

Unfortunately there are a large number of different methods for valuing this quality option (see for example, Hemler (1990)), which can give very different final values for the option. In choosing which method to use in this case, we felt that we should err on the

(2) The timing option that occurs in US and UK bond futures is not present in this case since the delivery time is fixed. The Bund contract does however have a new issue option (New issues can be added to the list of deliverables up to two week prior to the last trading day) see Lin and Paxson (1995). This option is the same in both LIFFE and DTB and so is ignored in our analysis

side of caution and choose a method that tends to give a high value to the option, and thus give us the highest chance of being able to explain the price difference. In practice, this meant choosing a Monte Carlo based method like that of Kane and Marcus (1986) since, as Hemler (1990) points out, this method tends to give a high value to the option.

Kane and Marcus value the quality option by first fitting a simple polynomial yield curve to the observed set of bond yields (US bonds in their case)

$$y = \beta_0 + \beta_1 T^{1/2} + \beta_2 T + \beta_3 T^2 + \beta_4 T^3 + C(\gamma_0 + \gamma_1 T) \qquad (2)$$

y = yield to maturity
T = time to maturity
C = Coupon rate of bond
β, γ = parameters to be estimated

They suggest that the first five terms of the equation describe a 'pure' zero coupon yield curve while the last two terms (γ_0, γ_1) allow for time-to-maturity-dependent coupon effects. Having estimated this cross-sectional equation on monthly data between 1978 and 1982, they then use the variance-covariance matrix of innovations to the coefficients of this equation as the basis of their Monte Carlo simulations. Using a fixed initial term structure they generated 1000 possible structures at contract maturity (a contract life of three months was assumed) and used the distribution of these outturns to value the quality option. They found that, over this three month period, its value ranged from about 2%-6% of the contract value.

Our approach, although based on Kane and Marcus, differs in one main respect. Instead of using the somewhat *ad hoc* functional form of equation (2), we used an explicit yield curve formulation based on the work of Nelson and Seigal (1987) and Svensson (1995). These are based directly on fitting the forward curve (through the discount function) and so, unlike yield based specification such as equation (2) they directly impose the restriction that cashflows receivable at the same date are discounted at the same rate (see Anderson et al. (1996)).

$$f(m) = \beta_0 + \beta_1 \exp(m/\tau_0) + \beta_2 \exp\left[(m/\tau_0)\exp(-m/\tau_0)\right] + \beta_3 \exp\left[(m/\tau_1)\exp(-m/\tau_1)\right] \qquad (3)$$

$f(m)$ = forward rate at maturity m
β, τ = Parameters to be estimated

We then estimated a set of daily yield curves for German Government Bonds for the three months before trading ceased on the September and December 1994 LIFFE contracts. We then used the variance/covariance matrix to generate a range of bond prices for the deliverables for the last DTB trading day. We generated 10,000 possible one day yield curve movements for the day on which the DTB is trading and LIFFE is not in order to estimate the value of the one day delivery option of the DTB. If there was a possibility of the CTD changing on this day then the DTB futures should reflect this with a higher value of the delivery option. In fact, we found that even over 10,000 runs the possibility of this event occurring on the last DTB trading day was indistinguishably different from zero (i.e. no different from zero in units of one hundredth of a basis point).

This result was unsurprising for two reasons. First, the chance of a change in CTD over one day is very small (Hemler estimates the three month delivery option for the US T-bond future to be worth less than 30 basis points). Secondly, the Bund contract is unusual in having a small number of very similar deliverables (the maturity range on the Bund contract is 8.5 to 10 whilst the US T-bond is 15 years up and the UK Long Gilt is 10 to 15 years) of relatively short duration, in a market that is relatively stable. These factors mean that the correlation between the fitted (i.e. derived from the yield curve estimation procedure described above) prices of bunds in the basket of deliverables is extremely high (see Table 2) reducing the probability of a large relative price movements between them.

Table 2: Correlation coefficients for fitted values of the basket of deliverables for the December 1994 Bund contract

	6.5%03B	6.75%04	7.5%04	6.25%04T	6.75%04T	7.5%04T	6.0%03T	6.63%03T	6.88%03T
6.5%03A	1.000	.9964	.9972	.9987	.9959	.9972	1.000	1.000	1.000
6.5%03B		.9968	.9975	.9990	.9963	.9975	1.000	1.000	1.000
6.75%04			.9999	.9994	1.000	.9999	.9968	.9963	.9961
7.5%04				.9997	.9998	1.000	.9975	.9971	.9970
6.25%04T					.9992	.9997	.9989	.9986	.9985
6.75%04T						.9998	.9963	.9958	.9955
7.5%04T							.9975	.9971	.9970
6.0%03T								1.000	.9999
6.63%03T									1.000

Notes: Bonds in the basket of deliverables identified by their coupon (rounded to two decimal places in some cases) and maturity date. T identifies Treuhand Bonds. Bonds with identical coupons and maturity year are distinguished by A and B suffix

Although the Monte Carlo approach of Kane and Marcus is thought to over-estimate the value of the quality option over long horizons, there are good reasons to believe that it may under-estimate the value of short-horizon options such as the one analysed here. As Barnhill (1990) points out, much of the variation in bond prices over the short term is due to temporary disequilibria or 'noise'. This noise can be characterised by the movement of individual bonds relative to the yield curve rather than movement of the curve itself as analysed above. In order to allow for this effect we used a simpler Monte Carlo method of valuing the quality option. The approach is based on estimating the variance/covariance matrix of actual bond prices rather than the yield curve and using this as the basis of the one-day ahead simulations. As table 3 shows, the correlations between actual bond prices in the basket is far lower than the correlations of the fitted values and so are likely to give a higher value to the option.

Table 3: Correlation coefficients for actual values of the basket of deliverables for the December 1994 Bund contract (November 8th to December 8th 1994)

	6.5%03B	6.75%04	7.5%04	6.25%04T	6.75%04T	7.5%04T	6.0%03T	6.63%03T	6.88%03T
6.5%03A	.9858	.9882	.6932	.6387	.6594	.7013	.6454	.6358	.6308
6.5%03B		.9764	.7061	.6666	.6850	.7360	.6787	.6600	.6624
6.75%04			.7005	.6630	.6884	.7112	.6676	.6601	.6531
7.5%04				.9233	.9075	.8714	.9196	.9228	.9130
6.25%04T					.9765	.9021	.9948	.9746	.9789
6.75%04T						.9064	.9787	.9697	.9664
7.5%04T							.8974	.9102	.8926
6.0%03T								.9724	.9792
6.63%03T									.9715

Notes: as for table 2

In general, table 3 shows that the correlation between Treuhand and non-Treuhand bunds is particularly low though all correlations are lower than in table 2. Clearly, using this variance/covariance matrix is prone to a number of problems in the longer run since it does not capture the tendency of bonds to return to the yield curve over time or the broader changes involved in the evolution of the yield curve through time. However, for our purposes, namely estimating one day ahead price movements, it has the advantage of capturing movements of individual bonds relative to the yield curve which can be important on a day-to-day basis (it also has this advantage over methods based on equilibrium models of the term structure like that of Broadie and Sundaresan (1991)).

Generating the value of the one day ahead quality option using this approach we find two significant values for the quality option for the four contracts between September 1994 and June 1995 (0.0009 and 0.0013, 0.001% and 0.0016% of the futures price, for the

September 1994 and June 1995 contracts respectively). So even using this methodology the one day quality option does not seem to be valuable enough to explain the price difference between these two contracts.

Penalty for late delivery

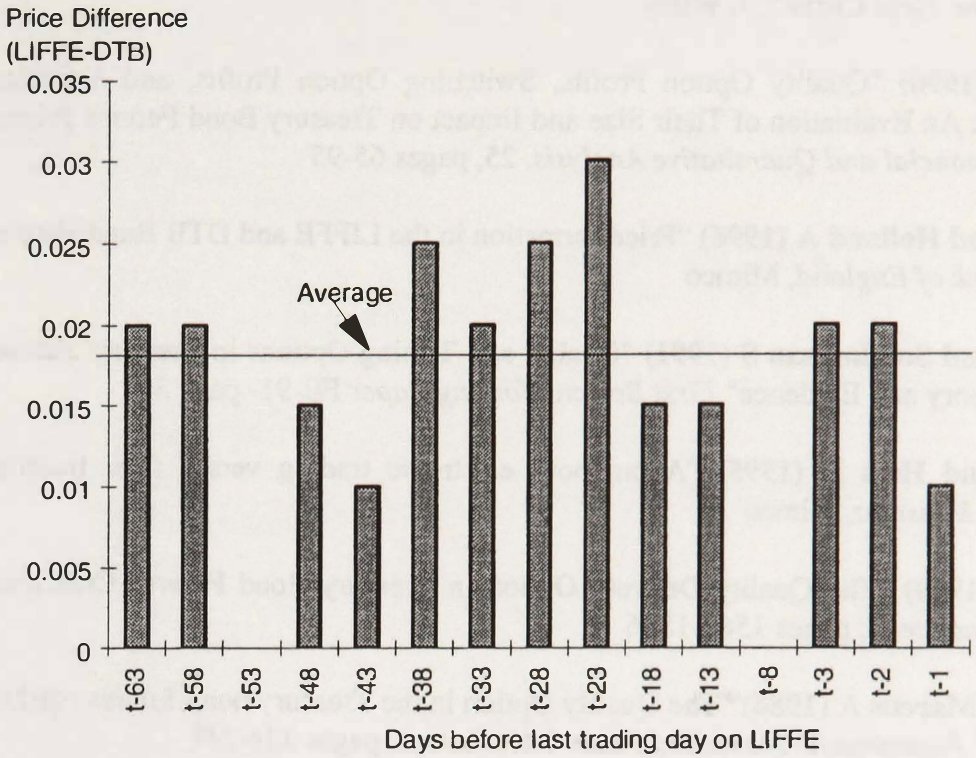
An important difference between the contracts are the rules concerning late delivery of bonds by the short. In the LIFFE contract, if the short fails to deliver the appropriate amount with the clearing house, the penalty is rigidly specified and it can be severe, including expulsion from the exchange. In the DTB, on the other hand, the penalty was (until recently) low. The short was required to pay the Lombard Rate+1% for the period of non-delivery.

At first sight this may seem sufficient penalty to ensure that the short will not have an incentive to deliver late since the Lombard Rate is effectively the risk free rate. However, if traders face some risk of a short squeeze (i.e. a rise in the price of the CTD on delivery day due to excess demand from holders of short positions) then the short may be willing to pay the low penalty in order to avoid delivering a bond whose price is temporarily inflated. Since the option of late delivery is valuable to the short at the cost of the long then this penalty may reduce the futures price (This phenomenon is related to the timing option available in other futures contracts).

Valuing this option presents a number of difficulties. Firstly, the event of a short squeeze is likely to be rare but costly and so estimating its value is problematic. Secondly, there is as yet no reliable method of estimating the value of both a timing and quality option simultaneously since their values interact. In this case the interaction is added to by the fact that if the CTD is very close to another bond then the possibility of a short squeeze is much diminished. Fortunately, we have a far simpler way of gauging the importance of this delivery effect since in May 1995 the DTB tightened their delivery procedures to remove the possible incentive to deliberately delay delivery. The new rules allow the clearing house to borrow the required bonds at the short's expense and to charge an additional penalty of the Lombard rate + 1 and 1000 DM per contract.

Chart 3 shows the difference in contract price for the September and December Contracts subsequent to the rule change. The rule change appears to have had no discernible effect on the price difference and the average price difference remains at about 1.5 basis points. This suggests that different penalties for late delivery are not an important factor in explaining the price difference

Chart 3: Average Price differences between LIFFE and DTB contracts - September and December 1995



IV. CONCLUSION

The Bund futures contract has become increasingly popular test bed for theories of market microstructure. It is highly liquid and informationally efficient and traded simultaneously on two very different trading systems. However, rather than focusing on 'traditional' microstructure issues this paper has analysed a surprising aspect of these contracts - persistent, if small, differences in pricing. We have found that although the seemingly identical Bund contracts traded on LIFFE and the DTB do differ slightly in specification, these differences do not seem to be large enough to explain the pricing difference. Although our inability to explain this pricing difference is somewhat disappointing it does raise questions about how dually traded futures prices are tied both to each other and the underlying asset when physical delivery is rare.

References

Anderson N, Breedon F, Deacon M, Derry A and Murphy G (1996) "*Estimating and Interpreting the Yield Curve*", J. Wiley

Barnhill T (1990) "Quality Option Profits, Switching Option Profits, and Variation Margin Costs: An Evaluation of Their Size and Impact on Treasury Bond Futures Prices" *Journal of Financial and Quantitative Analysis*, 25, pages 65-95

Breedon F and Holland A (1996) "Price formation in the LIFFE and DTB Bund Futures Contract" *Bank of England*, Mimeo

Broadie M and Sundaresan S (1991) "Quality and Timing Options in Treasury Futures Markets - Theory and Evidence" *First Boston Working Paper* FB-91- page 26

Franke G and Hess D (1995) "Anonymous electronic trading versus floor trading" *University of Konstanz,* mimeo

Hemler M (1990) "The Quality Delivery Option in Treasury Bond Futures Contracts" *Journal of Finance*, 5, pages 1565-1586

Kane A and Marcus A (1986) "The Quality Option in the Treasury bond futures market: An Empirical Assessment" *Journal of Futures Markets*, 6, pages 231-248

Kofman P and Moser J (1996) "Spreads, Information Flows and Transparency Across Trading Systems" *Journal of Applied Finance* forthcoming

Lin B and Paxson D (1995)"Term Structure Volatility and Bund Futures Embedded Options" *Journal of Business Finance and Accounting*, 22, pages 101-127

Nelson C and Seigal A (1987) "Parsimonious modeling of Yield Curves" *Journal of Business* 60, pages 473-489

Pirrong C (1994) "Derivatives Exchanges, Liquidity and locals: A look into the future" *Catalyst Institute*

Shyy G and Lee J (1995) "Price Transmission and Information Asymmetry in Bund Futures Markets: LIFFE vs. DTB" *Journal of Futures Markets* 15, pages 87-99

Svensson L (1995) "Estimating Forward Interest Rates with the Extended Nelson & Siegal Method" *Sveriges Riksbank Quarterly Review.*

Bank of England Working Paper Series

Publication date in italics

1	Real interest parity, dynamic convergence and the European Monetary System *(June 1992)*	Andrew G Haldane Mahmood Pradhan
2	Testing real interest parity in the European Monetary System *(July 1992)*	Andrew G Haldane Mahmood Pradhan
3	Output, productivity and externalities—the case of banking *(August 1992)*	R J Colwell E P Davis
4	Testing for short-termism in the UK stock market *(October 1992)*	David Miles
5	Financial deregulation and household saving *(October 1992)*	Tamim Bayoumi
6	An investigation of the effect of funding on the slope of the yield curve *(January 1993)*	D M Egginton S G Hall
7	A simple model of money, credit and aggregate demand *(April 1993)*	Spencer Dale Andrew G Haldane
8	Bank credit risk *(April 1993)*	E P Davis
9	Divisia indices for money: an appraisal of theory and practice *(April 1993)*	Paul Fisher Suzanne Hudson Mahmood Pradhan
10	The effect of official interest rate changes on market rates since 1987 *(April 1993)*	Spencer Dale
11	Tax specific term structures of interest rates in the UK government bond market *(April 1993)*	Andrew J Derry Mahmood Pradhan
12	Regional trading blocs, mobile capital and exchange rate co-ordination *(April 1993)*	Tamim Bayoumi Gabriel Sterne
13	Temporary cycles or volatile trends? Economic fluctuations in 21 OECD countries *(May 1993)*	Gabriel Sterne Tamim Bayoumi
14	House prices, arrears and possessions: A three equation model for the UK *(June 1993)*	F J Breedon M A S Joyce

15	Tradable and non-tradable prices in the UK and EC: measurement and explanation *(June 1993)*	C L Melliss
16	The statistical distribution of short-term libor rates under two monetary regimes *(September 1993)*	Bahram Pesaran Gary Robinson
17	Interest rate control in a model of monetary policy *(September 1993)*	Spencer Dale Andrew G Haldane
18	Interest rates and the channels of monetary transmission: some sectoral estimates *(September 1993)*	Spencer Dale Andrew G Haldane
19	The effect of futures trading on cash market volatility: evidence from the London stock exchange *(December 1993)*	Gary Robinson
20	M0: causes and consequences *(December 1993)*	F J Breedon P G Fisher
21	An empirical analysis of M4 in the United Kingdom *(December 1993)*	P G Fisher J L Vega
22	A model of building society interest rate setting *(June 1994)*	Joanna Paisley
23	Deriving estimates of inflation expectations from the prices of UK government bonds *(July 1994)*	Mark Deacon Andrew Derry
24	Estimating the term structure of interest rates *(July 1994)*	Mark Deacon Andrew Derry
25	Potential credit exposure on interest rate swaps *(August 1994)*	Ian Bond Gareth Murphy Gary Robinson
26	New currencies in the Former Soviet Union: a recipe for hyperinflation or the path to price stability? *(September 1994)*	C L Melliss M Cornelius
27	Inflation, inflation risks and asset returns *(November 1994)*	Jo Corkish David Miles

28	The construction of RPIY *(February 1995)*	R Beaton P G Fisher
29	Pricing deposit insurance in the United Kingdom *(March 1995)*	David Maude William Perraudin
30	Modelling UK inflation uncertainty: the impact of news and the relationship with inflation *(April 1995)*	M A S Joyce
31	Measuring core inflation *(April 1995)*	Danny T Quah Shaun P Vahey
32	An assessment of the relative importance of real interest rates, inflation and term premia in determining the prices of real and nominal UK bonds *(April 1995)*	David G Barr Bahram Pesaran
33	Granger causality in the presence of structural changes *(May 1995)*	Marco Bianchi
34	How cyclical is the PSBR? *(May 1995)*	Joanna Paisley Chris Salmon
35	Money as an Indicator *(May 1995)*	Mark S Astley Andrew G Haldane
36	Testing for convergence: evidence from nonparametric multimodality tests *(June 1995)*	Marco Bianchi
37	Wage interactions: comparisons or fall-back options *(August 1995)*	Jennifer C Smith
38	The microstructure of the UK gilt market (*September 1995*)	James Proudman
39	Valuation of underwriting agreements for UK rights issues: evidence from the traded option market (*September 1995*)	Francis Breedon Ian Twinn
40	Rules, discretion and the United Kingdom's new monetary framework (*November 1995*)	Andrew G Haldane
41	Optimal commitment in an open economy credibility vs flexibility (*December 1995*)	Sylvester Eijffinger Eric Schaling

42	Bidding and information: Evidence from gilt-edged auctions (*January 1996*)	Francis Breedon Joe Ganley
43	International bank lending to LDCs—an information-based approach (*February 1996*)	Prasanna Gai
44	A comparison of methods for seasonal adjustment of the monetary aggregates *(March 1996)*	Marco Bianchi
45	Base money rules in the United Kingdom (*March 1996*)	Andrew G Haldane Bennett T McCallum Chris Salmon
46	A market for intra-day funds: does it have implications for monetary policy? (*March 1996*)	Spencer Dale Marco Rossi
47	Measurement bias in price indices: an application to the UK's RPI (*March 1996*)	Alastair W F Cunningham
48	The construction of the Bank's new UK commodity price index (*March 1996*)	Andrew Logan Lucy O'Carroll
49	Independence and accountability *(April 1996)*	Clive B Briault Andrew G Haldane Mervyn A King
50	Unemployment persistence: Does the size of the shock matter? *(June 1996)*	Marco Bianchi Gylfi Zoega
51	UK asset price volatility over the last 50 years *(June 1996)*	Nicola Anderson Francis Breedon
52	Feasible mechanisms for achieving monetary stability: a comparison of inflation targeting and the ERM *(July 1996)*	Matthew B Canzoneri Charles Nolan Anthony Yates
53	What determines the short-run output-inflation trade-off? *(July 1996)*	Anthony Yates Bryan Chapple
54	Monetary policy uncertainty and central bank accountability *(October 1996)*	Charles Nolan Eric Schaling
55	The information content of the short end of the term structure of interest rates *(October 1996)*	Marco Rossi