The determinants of successful financial innovation: an empirical analysis of futures innovation on LIFFE

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Abstract

This paper documents contract innovation in the context of the London International Financial Futures Exchange (LIFFE). We find that most of LIFFE's contracts met traditional benchmarks of success in their early years of trading. This however, proved to be neither a necessary nor a sufficient condition for success. Market liquidity in terms of both execution risk and transaction costs is shown to be fairly constant across active LIFFE contracts. As expected, we find that contract success is highly correlated with the size of the underlying market, as well as with its volatility. We further confirm the existence of a first-mover advantage.

1 Introduction

Financial futures exchanges around the world have seen tremendous growth in their trading volumes in the last decade. While much of this growth was fueled by the [ever-increasing] interest in financial derivatives, exchanges have also tried to increase their market shares through a combination of product innovation, improvements in trading technology and, more recently, by creating alliances between markets. This paper explores the role of product innovation in the context of the London International Financial Futures Exchange (LIFFE).

Since its inception in 1982, LIFFE has created interest rate, foreign exchange and stock index futures and options with, as we shall see below, varying degrees of success. Nevertheless, LIFFE has grown to become the third largest futures exchange in the world, leaving its European rivals, MATIF and DTB, well behind. In this paper, we document futures innovation on LIFFE by empirically analysing the individual growth profiles of its futures contracts and the factors that determine contract success or failure.

Using different measures of success, the paper documents considerable heterogeneity across contracts, and finds that contract success cannot easily be inferred from the contract's first years of trading. As expected, we find contract success to be highly correlated with the size of the underlying market, as well as with its volatility. We also confirm the existence of a first-mover advantage.

When measuring trading costs, we find little systematic correlation between bid-ask spreads and futures volume. This suggests that there may be a critical level of trading activity beyond which bid-ask spreads and execution risk vary relatively little. We conclude that liquidity seems to be a consequence rather than a cause of contract success (or lack of liquidity a cause of failure).

These results may provide a useful perspective as exchanges prepare themselves for monetary unification. Successful product innovation will be critical since exchanges may face a drop in demand with reduced monetary uncertainty, and a narrowing of the current spectrum of interest rate contracts to euro contracts only.[1] A related question is whether a futures markets needs a well-developed spot market to succeed, or whether the creation of a futures market could help to boost liquidity in a fledgling spot market. This issue has been raised in recent discussion regarding liquidity in the index-linked gilt market.[2]

2 Financial innovation on LIFFE, 1982-1994: an overview

2.1 Contract success and failure

This section provides a general description of futures innovation and its successes on LIFFE since the creation of the exchange in 1982. Table A lists all contracts created by LIFFE, and provides some general information about their life span and the presence of competing contracts. Between 1982 and 1994, LIFFE introduced a total of 25 contracts, twelve of which failed. This represents a 48% failure rate.[3] LIFFE was the innovating exchange or first mover in eleven cases: eight (73%) of the first-mover contracts are still trading as of 1994, whereas the corresponding number for the second contracts, where LIFFE duplicated existing futures, is five (36%). These results are consistent with the City Research report (1994), and confirm the existence of a first-mover advantage.

Dual listing affects LIFFE in two ways: eight contracts (32% of all contracts) have (had) identical contracts listed on competing exchanges with identical or very similar trading hours; 13 contracts (52%) have (had) cross-listed contracts in markets with non or partially overlapping trading hours. Interestingly, contracts with simultaneously trading competitors have a higher success rate (five out of eight are still alive in 1994) than either those with non-simultaneous competitors (six out of 13 alive), or those with no cross-listed contracts (three out of six alive). This indicates that cross listing may contribute to the liquidity of a contract. In Section 4, we will investigate this further.

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(1) See the *Economist*, 7 September 1996, pages 87-88.

(2) See Bank of England (1996), *Index-Linked Debt*, Papers presented at the Bank of England Conference, September 1995.

(3) By comparison, Tashjian (1995) reports that of 85 futures contracts trading in three selected years (1984, 1989 and 1993) on the CME and the CBOT, only 24 traded in all three years.

Table A
List of LIFFE contracts, 1982 to 1994

Contract	Life span	LIFFE=1st	multiple markets	simultaneous
ECU	1989 - date	no	yes	no
DM	1982 - 1990	no	yes	no
SF	1982 - 1990	no	yes	no
$DM	1986 - 1990	no	yes	no
£$	1982 - 1990	no	yes	no
Yen	1982 - 1990	no	yes	no
Eurodollar	1982 - date	no	yes	no
Short £	1982 - date	yes	no	-
Euroecu	1989 - date	no	yes	no
Euromark*	1989 - date	yes	yes	yes/no
Euroswiss	1991 - date	yes	yes	yes
Eurolira	1992 - date	yes	no	no
Bund	1988 - date	yes	yes	yes
Bobl	1993 - 1994	no	yes	yes
US T-bond	1984 - 1993	no	yes	no
Long gilt	1982 - date	yes	no	-
Short gilt	1985 - 1990	yes	no	-
Medium gilt	1988 - 1990	yes	no	-
JGB**	1987 - date	no	yes	no
ECU Bond	1991 - 1992	no	yes	yes
It. Gov. bd.	1991 - date	yes	yes	yes
Sp. Gov Bd	1993 - 1993	no	yes	yes
FTSE-100	1984 - date	yes	yes	no
FTSE-250	1994 - date	no	yes	yes
Eurotrack***	1991 - 1992	yes	no	no

Notes: Table A lists all contracts created by LIFFE. The second column gives year of introduction and of delisting, if applicable. Column three indicates whether LIFFE was the first mover (yes). Columns four and five respectively, indicate whether a cross-listed futures exists (yes) and whether it is trading simultaneously (yes). *: The Euromark is cross-listed on MATIF and on CME. **: A first Japanese bond contract was introduced in 1987; replaced by the New Japanese bond contract in 1990. This replacement is not considered an innovation. ***: A similar contract is the Eurotop, listed on several European futures exchanges.

Table B provides more information about contract failure and success. Of all contracts introduced by LIFFE, the majority have traded for more than three years, the critical number used in most empirical studies (panel 1).[4] Panel 2 looks at the lifetime of surviving futures and confirms this number. By contrast, contract failure is as likely to occur in the first two years as after six years (in both cases, five contracts were delisted) (see panel 3). It is not clear whether this represents a delayed action by the exchange to delist the unsuccessful contracts or a change in market conditions after a period of successful trading.[5]

2.2 Measures of contract success: methodology

In this Section, we evaluate several measures of contract success (or failure). We first follow the literature in its use of volume and open interest as measures of success. In Silber's (1981) study of financial innovation by US futures exchanges between 1960 and 1980, contract success is defined by (i) the number of years a contract is trading, and (ii) annual volume exceeding 10,000 contracts.[6] Carlton (1984) analyses longevity and competition for US futures contracts between 1921 and 1983, and relies on average lifetime and survival rates.[7] Black (1986) uses the Wall Street Journal's criterion for listing a futures contract in its financial pages: ie a contract is considered successful if its daily open interest exceeds 5,000 contracts and if its daily trading volume exceeds 1,000 contracts. She further relates average daily futures volume during the first three years of a new contract to residual risk.

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(4) See eg Silber (1981), Carlton (1984), and Black (1986).

(5) Carlton (1984) finds that a large number of contracts die within the first two years of their introduction. By contrast, Tashjian, Johnston and McConnell (1989) document the initial success and subsequent decline of the GNMA futures on the CBOT.

(6) Silber's empirical tests show that 32% of all contracts listed between 1960 and 1977 were still trading in 1980, whereas 24% of all contracts reached annual volumes in excess of 10,000 contracts after three years. The largest exchanges, the CME and CBOT, did even better, with 43% and 30%, respectively.

(7) Carlton concludes that the rate of product failure was high, with a median lifetime for all contracts of seven years. A majority of all futures failed within ten years of introduction, with most perishing in the first two years. The more successful contracts, however, were concentrated on the larger exchanges.

Table B.
Contract success: lifetimes

1 Contract lifetimes

Number of years contract is trading	Number of contracts
less than 1	2
1 - 2	5
3 - 5	7
6 - 10	8
more than 10	3

2 Contract lifetimes for surviving contracts

Number of years contract is trading	Number of contracts
less than 1	1
1 - 2	1
3 - 5	5
6 - 10	3
more than 10	3

3 Contract lifetimes for delisted contracts

Number of years contract is trading	Number of contracts
less than 1	1
1 - 2	4
3 - 5	2
6 - 10	5
more than 10	-

Notes: Table B, panel 1 tabulates the distribution of contract lifetimes for all contracts introduced by LIFFE between 1982 and 1994. In total, LIFFE introduced 25 futures contracts over a twelve-year period. Panel 2 tabulates the distribution of contract lifetimes for all contracts introduced by LIFFE between 1982 and 1994, that were still in existence as of October 1994 (a total of 13). Panel 3 tabulates the distribution of contract lifetimes for all contracts introduced by LIFFE between 1982 and 1994 that had ceased to exist as of October 1994 (a total of twelve).

2.3 Measures of contract success: results

Chart 1 shows daily volume for 16 LIFFE futures, eleven of which were still in existence at the end of our sample period (October 1994). We look at average daily volume in the first, third, sixth and tenth year of a contract's existence.[8] Chart 1 shows that all contracts grew over time, except for the three-month euro$ future, which fell in its first year. The fastest growing contract is the three-month euroDM. Chart 1 also shows the growth of LIFFE's total contract volume. While volume levels remain relatively low during the first three years of its existence, they take off thereafter. This corresponds to the wave of innovations after 1989, the high growth rates of some of these new contracts (eg Bund, euroDM), and the late acceleration in growth of some of the early contracts (eg short).

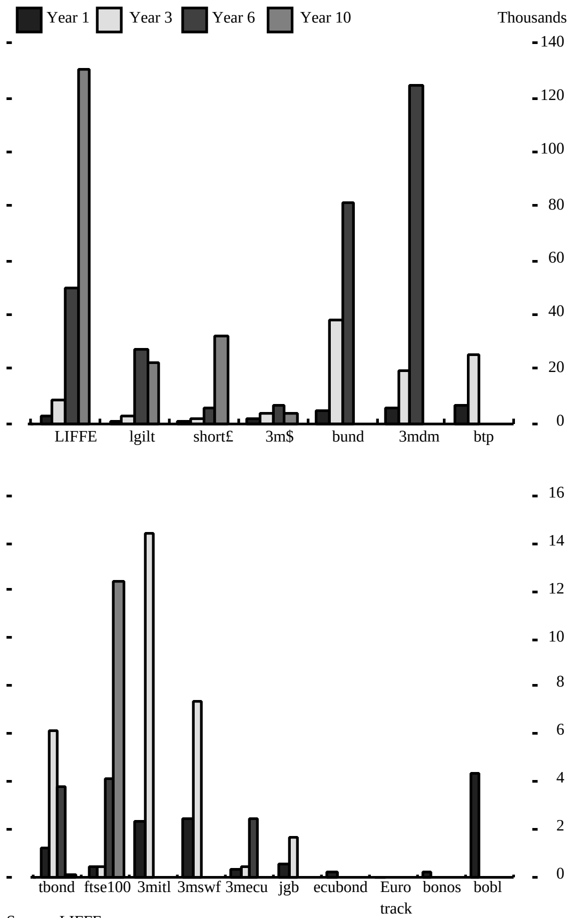
Chart 2 shows average daily open interest for years one, three, six and ten. Open interest, or the total number of outstanding contracts at the end of the day, provides a different measure of contract activity, as it excludes by definition all short-term trading by day traders, many of whom are inspired by speculative motives. Consequently, one could argue that open interest primarily reflects hedging demand (Bessembinder and Seguin (1993)). From Chart 2, we can see that this hedging demand shows the same heterogeneity as total trading volume. Open interest is the highest for the three-month DM contract. Again, it takes a while for open interest in the early contracts (long gilt, short, and three-month $) to take off.

Tables C1-C2 illustrate some further patterns in trading volume and open interest. First, the Tables indicate that all but two contracts exceed the Wall Street Journal criterion of 1,000 contracts traded per day in their third year. We also calculated (but do not report) total trading volume in the first year, and found that all but one contract exceed the 10,000 contracts benchmark used in previous empirical studies. This includes contracts such as the Bobl, Bonos or Ecubond, that were later delisted. Second, volume at identical points in the different futures' lifetimes differs greatly: the largest disparity

(8) Daily volume and open interest data are used to construct Charts 1-2 and Tables C and G-I. For charts 1-2, average daily futures volume and daily open interest were computed for the first, third, sixth and tenth year of a contract's existence (where applicable). This information is summarised in Tables C1 and C2. Both volume and open interest count the numbers of contracts traded. See Appendix A for more detailed information on the data sources.

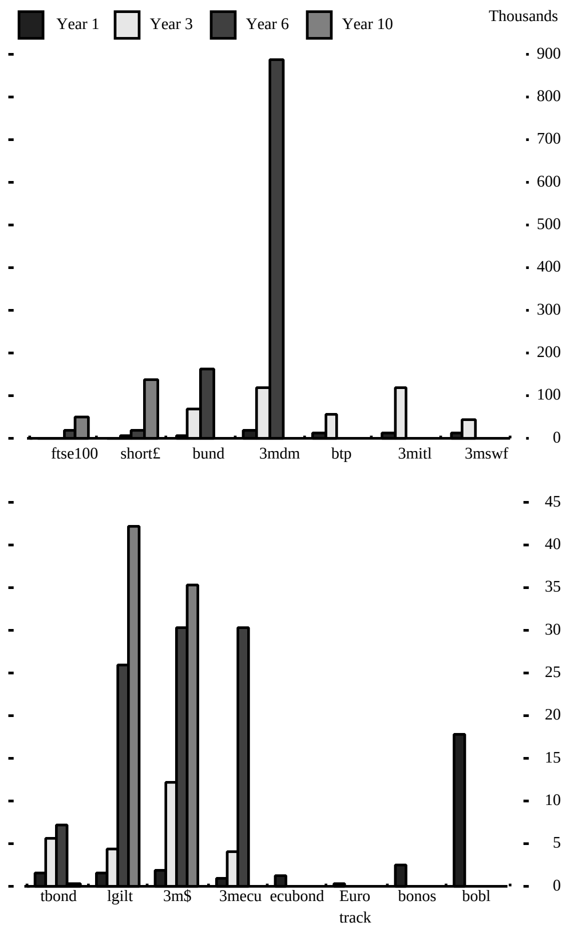
occurs in year six with the three-month euroDM trading on average more than 120,000 contracts per day, and the [T-bond futures just below 4,000.]

Chart 1
Average daily futures volume
Number of contracts



Source: LIFFE.

Chart 2
Average daily open interest
Number of contracts



Source: LIFFE.

Table C1
Average daily volumes

	Year												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
LIFFE	2,904	5,407	9,024	13,414	26,012	49,470	54,816	88,280	117,842	130,586	221,031	320,014	493,561
lgilt	962	2,094	3,064	2,722	10,323	27,584	22,084	16,121	22,393	22,289	34,664	46,676	83,981
short £	1,045	796	1,349	1,950	3,791	5,917	13,986	28,214	32,977	31,886	44,474	48,076	67,306
3m$	1,859	1,828	4,046	5,070	4,374	6,859	6,517	8,162	4,934	3,929	2,793	969	470
ftse100	438	351	484	1,819	1,843	4,080	5,709	6,839	10,298	12,365	17,507		
tbond	1,254	2,479	6,112	6,122	8,073	3,837	3,040	1,829	1,071	45			
bund	4,850	21,145	37,635	39,984	53,561	81,116	158,358						
3mecu	353	253	454	1,247	2,869	2,477							
3mdm	5,374	10,513	18,914	47,927	84,634	124,425							
jgb	529	872	1,672	2,511									
3mswf	2,415	7,758	7,320	7,026									
btp	6,715	14,855	25,219	52,322									
3mitl	2,290	5,863	14,390										
bobl	4,379	422											
ecubond	261	34											
Eurotrack	21	0											
bonos	223												

Table C2
Average daily open interest

	Year												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
lgilt	1,413	3,357	4,479	4,341	13,775	25,959	32,198	28,955	33,430	42,134	62,405	87,580	128,424
short £	2,150	4,043	7,154	6,653	14,546	19,889	38,414	89,517	159,689	137,115	221,220	331,212	489,427
3m$	2,003	5,490	12,188	17,905	21,185	30,234	34,473	48,332	37,159	35,238	32,265	15,454	9,083
ftse100	949	1,606	2,368	6,207	11,474	23,239	24,777	33,732	42,815	54,730	61,595		
tbond	1,547	2,690	5,674	5,914	8,777	7,201	5,800	5,046	2,688	312			
bund	8,760	33,870	71,182	79,924	124,685	163,392	179,502						
3mecu	1,011	2,557	3,950	10,034	25,622	30,146							
3mdm	18,976	61,254	120,670	308,325	595,034	888,147							
3mswf	16,800	40,209	45,600	51,111									
btp	14,053	30,317	58,098	81,956									
3mitl	17,509	66,750	123,158										
bobl	17,817	3,166											
ecubond	1,258	77											
Eurotrack	245	76											
bonos	2,420												

Third, the Tables show that contracts launched after derivative markets were more established were more likely to grow faster in their initial years than contracts launched earlier. For example, the short-term interest futures created in the early ’80s (three-month euro$ and short sterling) had lower volumes in their first and third years than those created at the end of the decade (three-month euroDM, three-month euroSF and three-month eurolira).[9] It could be argued that a more mature exchange is able to commit more capital to launch a new product, leading to a quicker take-off in volume and lower probability of failure. Likewise, Gale (1994) suggests that ‘product uncertainty’ may initially hinder innovation as people are unfamiliar with new instruments. The later futures contracts, however, should suffer less from this phenomenon, as reflected in the higher growth rates of their early years of trading.

Fourth, the results indicate that high volume in the first year is neither a sufficient, nor a necessary condition, for a contract to succeed. For example, the Bobl contract had an average trading volume of over 4,000 contracts in its first year, but was delisted one year later, whereas the highly successful FTSE-100 futures only reached an average of 4,000 contracts in its sixth year.

When looking at open interest in Table C2, we confirm the above trends. The Wall Street Journal criterion for open interest of 5,000 contracts per day is met by eight out of ten contracts in their third year of trading. Again, high open interest in the first year is neither a necessary, nor a sufficient condition for a contract to succeed.[10]

We also compute the ratio of futures volume to open interest. One could interpret this ratio as an approximate measure of liquidity. A high ratio, indicating that trading is high compared to the number of outstanding contracts, would imply that agents can enter and liquidate their positions

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(9) Volume of the three-month euro-ECU, however, is fairly low.

(10) We also computed a value ratio, defined as the value of futures volume divided by spot market capitalisation, which measures the relative importance of the derivative market compared to the underlying market (see eg Barclay (1994)). Value ratios are found to vary a lot across contracts, but are generally higher for the short-term interest rate futures than for the long-term products. Furthermore, they are generally unrelated to trading volume. For instance, the FTSE and Bund futures have relatively low value ratios, whereas their volume numbers would designate them as successful. The highest value ratio in years one and three belongs to the eurolira contract, which in terms of volume comes only sixth in its first year, and fourth in its third year of trading. These results are, however, subject to measurement errors, as approximate measures had to be used for spot market capitalisation. The complete set of results can be obtained from the authors.

with relative ease. We would expect this to be an attribute of contract success. The results in Table C3 seem to confirm this. Successful contracts such as the Bund or long gilt have high ratios from their first year onwards. By contrast, unsuccessful contracts such as the Bobl or the eurotrack futures exhibit very low ratios. Likewise, futures that are on the decline such as the T-bond and the three-month $ futures, see a pronounced drop in their ratio, reflecting a faster decrease in their trading activity than in the number of outstanding contracts. At the same time these contracts illustrate that a high ratio in the first year is no guarantee of success later on.

Table C3
Volume-open interest ratio

	Yea												
Contract	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
lgilt	0.68	0.62	0.68	0.63	0.75	1.06	0.69	0.56	0.67	0.53	0.56	0.53	0.65
short£	0.49	0.20	0.19	0.29	0.26	0.30	0.36	0.32	0.21	0.23	0.20	0.15	0.14
3m$	0.93	0.33	0.33	0.28	0.21	0.23	0.19	0.17	0.13	0.11	0.09	0.06	0.05
ftse100	0.46	0.22	0.20	0.29	0.16	0.18	0.23	0.20	0.24	0.23	0.28		
tbond	0.81	0.92	1.08	1.04	0.92	0.53	0.52	0.36	0.40	0.14			
bund	0.55	0.62	0.53	0.50	0.43	0.50	0.88						
3mecu	0.35	0.10	0.11	0.12	0.11	0.08							
3mdm	0.28	0.17	0.16	0.16	0.14	0.14							
3mswf	0.14	0.19	0.16	0.14									
btp	0.48	0.49	0.43	0.64									
3mitl	0.13	0.09	0.12										
bobl	0.25	0.13											
ecubond	0.21	0.45											
Eurotrack	0.08	0.00											
bonos	0.09												

3 A further characterisation of success: market liquidity

3.1 Methodology

In the previous Section, we have tried to define success in quantitative terms, using conventional measures of contract volume and value. We found that the 10,000 contracts per year benchmark was reached by all but one contract in the first year. The Wall Street Journal criterion of 1,000 contracts traded per day would designate all but two contracts as successful. By contrast, contracts that were later delisted did meet those same criteria in their early years. Clearly, more precise measures of success are required.

In this Section, we search for an alternative definition of contract success by analysing market liquidity characteristics for 12 LIFFE contracts.[11] We define a successful market as a liquid market, namely a market that can at all times accommodate large (uninformed) orders, with minimal price impact. All other things equal, traders will prefer a liquid futures market, because trading costs (ie the bid-ask spread) and execution risk (ie the risk that adverse price movements occur before trade execution) will be lower.[12] Liquidity will in turn generate volume and liquidity, and further contribute to a contract's success.[13] We use tick - by - tick data for three days: 26 January 1993, on which UK interest rates fell by 1%; 2 February 1993, and 19 May 1994, two days on which there was no 'news'.

We first quantify execution risk, ie the probability that a significant price change occurs between the submission and execution of a market order. Execution risk is determined by: (i) the frequency of trades arriving in the market (how long will it take to find a match); and (ii) intra-day price volatility (will prices move if a delay occurs). In the second instance, we will characterise liquidity by estimating bid-ask spreads. In a liquid market, we would expect bid-ask spreads to be small, since it is less risky for market-makers (or locals) to provide liquidity services.

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(11) We drop the Bonos, Ecubond and Eurotrack futures from our analysis because of lack of intra-day data.
(12) Although these two definitions of liquidity are related, they need not be satisfied at the same time. For example, traders may be willing to accept a longer execution time for large orders if this would minimise price impact. In a liquid market, the tradeoff between immediacy and price impact will be minimised.
(13) Both theoretical and empirical studies suggest that liquidity is an important measure of success. For example, Cuny (1993) shows that in addition to maximising residual risk, the optimal futures contract attracts a sufficiently large set of non-hedgers as liquidity providers by setting appropriate entry fees. Black (1986) argues that traders initially face a trade-off between the superior hedging performance of a new contract, and the higher liquidity but inferior hedging performance of existing contracts.

Table D
Market liquidity analysis: 26 January 1993

Leading	Daily volume	Daily value (£100,000)	Number	Size	Value	Frequency	Volatility	Spread
bund	74,600	71,251	1,740	42.87	40.95	2.8	0.006	0.009
ftse	20,316	14,536	1,481	13.72	9.82	2.9	0.026	0.018
long gilt	62,563	31,643	1,165	53.70	27.16	2.1	0.019	0.038
btp	15,359	13,176	1,110	13.84	11.87	1.9	0.009	0.009
short £	73,332	86,238	856	85.67	100.75	1.5	0.012	0.011
dm	44,429	42,086	754	58.92	55.82	1.3	0.006	0.010
bobl	6,899	6,896	412	16.75	16.74	0.7	0.006	0.005
sf	11,010	11,678	285	38.63	40.97	0.6	0.009	0.009
il	2,387	2,356	148	16.13	15.92	0.3	0.012	0.010
jgb	578	3,323	129	4.48	25.76	0.2	0.002	-
ecu	1,519	2,777	74	20.53	37.53	0.1	0.018	-
$	883	1,387	23	38.39	60.28	0.05	0.048	-

Notes: Rank correlations: volume volatility: -0.35; volume spread: 0.07

Table E
Market liquidity analysis: 2 February 1993

Leading	Daily volume	Daily value (£100,000)	Number	Size	Value	Frequency	Volatility	Spread
bund	32,895	32,282	1,179	27.90	27.38	1.9	0.006	0.009
ftse	14,564	10,333	1,273	11.44	8.12	1.6	0.019	0.022
long gilt	36,734	18,757	736	49.91	25.49	1.3	0.016	0.032
btp	13,161	11,436	951	13.84	12.02	2.5	0.008	0.011
short ,	31,504	37,135	490	64.29	75.79	0.9	0.005	0.006
dm	24,143	23,410	395	61.12	59.27	0.7	0.006	0.008
bobl	2,740	2,811	174	15.75	16.16	0.3	0.008	0.006
sf	8,392	9,018	262	32.03	34.42	0.5	0.006	0.009
il	1,071	1,074	58	18.47	18.52	0.1	0.007	-
jgb	943	5,755	163	5.79	35.31	0.3	0.005	0.003
ecu	554	1,032	38	14.58	27.15	0.08	0.009	-
$	1,155	1,933.60	28	41.25	69.06	0.05	0.005	-

Notes: Rank correlations: volume volatility: -0.56; volume spread: -0.13

Table F
Market liquidity analysis: 19th May 1994

Leading	Daily volume	Daily value (£100,000)	Number	Size	Value	Frequency	Volatility	Spread
bund	132,221	127,310	2,755	47.99	46.21	4.4	0.006	0.008
ftse	10,436	8,153	1,082	9.65	7.54	2.1	0.021	0.019
long gilt	107,495	57,275		65.54	34.92	3.0	0.017	0.010
btp	44,615	42,254	1,554	28.71	27.19	2.7	0.008	0.010
short £	10,558	12,498	119	88.72	105.03	0.2	0.005	0.008
dm	20,753	19,751	254	81.70	77.76	0.4	0.005	0.008
bobl	0	0	0	0.00	0.00	0.0	-	-
sf	4,517	5,100	131	34.48	38.93	0.2	0.006	0.008
il	4,257	4,112	53	80.32	77.59	0.0	0.005	0.007
jgb	352	2,543	66	5.33	38.53	0.1	0.006	0.007
ecu	2,646	4,818	56	47.25	86.03	0.1	0.005	-
$	61	96	6	10.17	16.05	0.02	-	-

Notes: Rank correlations: volume volatility: -0.54; volume spread: -0.26

The results of our analysis are summarized in Tables D (26 January 1993), E (2 February) and F (19 May 1994). Contracts are ranked by their trade frequency (column three). The first two columns provide total daily volume and value figures. Columns four and five give the average size and value per trade. Finally, columns six and seven provide estimates of intra-day volatility and the Roll spread estimator.(14)

3.2 Market activity and execution risk

Using Tables D, E and F we distinguish three groups of contracts. The most liquid contracts in terms of trade frequency are the Bund, FTSE, long gilt and BTP futures. All trade over one contract per minute in 1993 and over two contracts per minute in 1994. Total numbers of trades per day vary from 2,256 (Bund on 19 May 1994) to 668 (long gilt on 2 February 1993). The next group, henceforth labeled intermediate liquidity group, includes the

(14) Intra-day price volatility is defined as the standard deviation of the absolute value of adjacent price changes. Price changes are calculated in logarithmic form: $\ln(P_t/P_{t-1})$. The percentage bid-ask spread is estimated using the Roll procedure (see Roll (1984)), and is defined as 200 times the square root of minus the covariance of adjacent returns.

short sterling, EuroDM, and EuroSF on all three days, and the Bobl on 26 January 1993. Their characteristics vary: In 1993, futures in this group have frequencies ranging from one contract every 40 seconds (short sterling on 26 January 1993) to one contract every two minutes (EuroSF on 2 February 1993), with total trades ranging from 757 (short sterling on 26 January 1993) to 262 (EuroSF on 2 February 1993). In 1994, trade frequencies for this group are all around one contract every three minutes, and trades range from 110 to 136. The least active contracts have a frequency of less than one contract every three minutes. We choose to rank our futures data based on frequency, since this is an important determinant of execution risk, and hence of market liquidity. Indeed, tables D, E and F indicate that execution delays may be an issue for the less liquid contracts. To determine whether this leads to more pronounced execution risk, we next have a look at intra-day price volatility.

Column seven shows intra-day price volatility, measured as the logarithm of tick-by-tick price changes. Interestingly, volatility is fairly uniform in the first two groups, except for the domestic UK contracts (FTSE on all three days, short sterling on 26 January 1993 when interest rates fell): Intra-day price volatility ranges from 0.009% (EuroSF and BTP on 26 January 1993) to 0.005% (short sterling on 2 February 1993). Price volatility for the least liquid contracts is higher on 26 January 1993, but comparable to the more liquid futures on the remaining days.

Hence, we identify a group of futures with fairly uniform intra-day price volatility, but enormous differences in terms of their: i) daily trading volume (columns one and two); ii) trade frequency (column three) and iii) longevity (see Table A). Consequently, execution risk is not necessarily higher for intermediate or less liquid contracts. Although on average there may be a longer wait for orders to be executed, the possibility of an adverse price movement before the actual execution does not appear to be higher. This hypothesis is further confirmed by the rank correlation coefficients displayed in the respective Tables that test the null hypothesis of low intra-day price volatility and high daily volume, and that are insignificant. Notice also that while in 1993 the Bobl futures does not distinguish itself in terms of price volatility from the other contracts, on 19 May 1994 no trades take place, and in late 1994 the Bobl futures is delisted.

3.3 Estimated bid-ask spreads

Estimated bid-ask spreads in column eight provide us with additional information about market liquidity. Estimated spreads using the Roll estimator are fairly uniform, and are slightly below or above one tick size.[15] The rank correlation coefficients reject the hypothesis that high volume contracts have lower bid-ask spreads.

Interestingly, the bid-ask spreads do not reflect the large differences in trade size and value. Columns four and five reveal that average trade sizes are generally higher in the intermediate group than in either the high-trade frequency or the low-trade frequency group.[16] If liquidity is defined as the ability of traders to bring large orders to the market with minimal transaction costs, then the second group is certainly as liquid as the first, high-frequency group of contracts.

To conclude, our intra-day analysis indicates that market liquidity in terms of both execution risk and transaction costs is fairly constant across active LIFFE contracts. Except for the euro$ futures and the Bobl futures, all contracts have a daily average of over 1,000 contracts traded in 1994 (see Table C1). Except for the Bobl, all contracts have been trading for at least three years. Yet they vary widely, both in terms of daily volume (see Table C1) and market control (see Table C2). Hence, there may be a critical level of acceptance beyond which bid-ask spreads and execution risk vary relatively little.

Interestingly, the Bobl, which was delisted in late 1994, does not seem to present higher execution risk or transaction costs to traders. Consequently, liquidity seems to be a consequence rather than a cause of contract success (or lack of liquidity a cause of failure).

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(15) The minimum price change is 0.01% for most contracts, except FTSE (0.018%) and long gilt (0.03%). Recall however that the Roll estimator has a tendency to underestimate the true bid-ask spread (eg Bobl).

(16) We tested whether the estimated bid-ask spread is size related by computing the rank correlation coefficient between the average size per trade and the spread itself. The average size per trade was estimated as follows: daily volume/number of trades per day. If large trades have a strong market impact and widen the spread, then we would expect a large and negative coefficient (rejecting the null hypothesis of a perfect relationship between a small spread and large volume). The coefficient was close to zero on 26 January 1993 and 19 May 1994, indicating no relationship, and positive (0.71) on 2 February 1993, suggesting that larger trade sizes may be related to smaller spreads, not larger.

4 The determinants of success

The preliminary results of Section 3 indicate considerable heterogeneity in contract performance and success. Yet a few patterns emerge, such as the importance of the time of introduction. In this Section, we search for quantitative and qualitative factors explaining futures performance and success. In the first instance, we will quantify the relationship between success and some of the explanatory variables by using Spearman's rank correlation coefficient. In the second stage, a regression model is developed, using panel data. Our methodology is explained in detail in Appendix B. It should be noted that market incompleteness and financial innovation are often driven by the existence of market imperfections such as transaction costs, taxes, regulations[17] and information asymmetries, which cannot be addressed in this context because of a lack of data.[18] Success could further be determined by contract design details, such as contract size, tick size, or delivery specifications. These issues are better dealt with in a dual listing context (see eg Breedon (1996)), and are therefore left out of the current single market analysis.

4.1 A large and volatile spot market

The theoretical literature on financial innovation models futures exchanges as maximising their members' utility by maximising trading volume. In this context, Duffie and Jackson (1989) show that the optimal contract has perfect correlation with the risk-adjusted differential between total (non-hedged) endowments of long and short agents in the market. Duffie and Jackson (1989) and Tashjian and Weissman (1995) also show that asymmetries in hedging demand, arising from differences in endowments, risk tolerance and sensitivity to transaction costs, will generate high volume. Cuny (1993) takes a slightly different approach and models exchanges as maximising their revenues from entry fees, paid by non-hedging participants only. Optimal contracts in his model have maximum correlation with net hedging demand not met by existing contracts. Unfortunately, in his model exchanges may be ignoring markets with potentially high, but balanced

(17) See eg Miller (1989 and 1992) and Finnerty (1992).
(18) For example, Rahi (1995) incorporates both the hedging and the price discovery function of futures markets in an incomplete markets setting. He shows that under certain conditions, an optimal futures contract exists that improves both the allocational and informational efficiency of the economy.

hedging demand, since their objective is to attract fee-paying non-hedgers to the market.

Translated into empirical terms, the above theoretical results imply that contracts are more likely to succeed when (i) the underlying spot market is large and characterized by volatile prices and (ii) the contract's design provides maximum correlation with the risk of hedging, or maximum 'hedging effectiveness' (Ederington (1979)). (See Table G).

To prove the above hypotheses, we first compute the rank correlation coefficient between futures volume and the size of the underlying market (measured by market capitalisation). The results, shown in Table G, are positive as expected

Table G
Rank correlations

	Size of the spot market	**Spot volatility**
Futures volume		
Year 1	0.20	-0.38
Year 3	0.52*	-0.07
Year 6	0.37	-0.17
Year 10	-0.70	-0.10
Futures value		
Year 1	0.64*	-0.32
Year 3	0.73*	-0.14
Year 6	0.37	-0.02
Year 10	-0.70	-0.10
Open interest		
Year 1	0.36	-0.50
Year 3	0.40	-0.40
Year 6	0.05	-0.50
Year 10	-0.90	0.90

Notes: Table G shows rank correlation coefficients for the LIFFE futures contracts listed in Table C and their underlying markets, using daily data. Data were ordered in descending order. A correlation of 1 indicates perfect agreement between two variables, whereas a coefficient of -1 would indicate perfect disagreement. The correlations are used for the 1st, 3rd, 6th and 10th year of each futures, if still in use. A * indicates that the rank correlation coefficient is significantly different from 0. The significance test is only valid for n > 10, and was therefore not carried out for the 6th or 10th year.

but not always significant. When repeated using futures value instead of futures volume, the correlations are even stronger. Using open interest instead of volume produces slightly lower correlation coefficients.

The estimates of the simple regression model in Table H show that changes in spot market capitalisation do have a positive impact on the growth in futures volume, with all specifications producing significant coefficients. Hence, our results indicate that successful contracts benefit from a large spot market.

Table G further displays rank correlation coefficients for futures volume and spot volatility. We find that the coefficients are small and often negative. The results of Table H reveal positive, though not quite significant regression coefficients. Hence, our data weakly support the hypothesis that a volatile spot market is a necessary condition for a futures contract to be successful.

Table H
Panel regression

	Option-effect	First-mover effect	Competition effect
DSVOL	$0.324.*10^{-4}$ (4.36) *	$0.297*10^{-4}$ (3.76)*	$0.247*10^{-4}$ (2.08) *
DSVOLAT	$0.888*10^{8}$ (1.59)	$0.885*10^{8}$ (1.58)	$0.876*10^{8}$ (1.59)
DUMMIES:			
D0: OPTION	$-0.33*10^{5}$ (-0.43)		
D1: FIRSTM			
D2: COMPD		$0.115*10^{6}$ (2.22)*	
D3: COMPS			$-0.779*10^{5}$ (-2.0)*
			$0.127*10^{6}$ (0. 84)
R-squared	0.03	0.04	0.05

Notes: Table H reports the results for the regression:

$$DFVOL_{it} = \alpha + \beta_1 DSVOL_{it} + \beta_2 DSVOLAT_t + \beta_3 D_{it} + w_{it},$$

The dependent variable $DFVOL_{it}$ is the change in quarterly futures volume. The main explanatory variables are changes in quarterly spot market capitalization (*DSVOL*) and changes in spot market volatility (*DSVOLAT*). Volatility is defined as the quarterly average of daily closing price changes: $\log(C_t/C_{t-1})$. The following set of dummies is used in the regression: *D0* = 1 if the contract has an option; *D1* = 1 if the contract was a first-mover contract; *D2* = 1 if a cross-listed contract exists with non-overlapping trading hours; *D3* = 1 if a cross-listed contract exists with overlapping trading hours. Dummies take on the value one the first full quarter after the event (eg the creation of an option) took place.

Table I
Hedging effectiveness

5-day hedge	Total sample		Ten year success (N=5)	
	Average HE	Rank correlation	Average HE	Rank correlation
Year 1	0.538	-0.09	0.762	-0.70
Year 3	0.539	0.13	0.642	-0.30
Year 6	0.625	-0.12	0.755	0.60
Year 10	0.745	-0.20		

10-day hedge	Total sample		Ten year success (N=5)	
	Average HE	Rank correlation	Average HE	Rank correlation
Year 1	0.532	0.08	0.724	-0.70
Year 3	0.610	0.03	0.718	-0.30
Year 6	0.702	0.05	0.804	0.60
Year 10	0.762	-0.20		

20-day hedge	Total sample		Ten year success (N=5)	
	Average HE	Rank correlation	Average HE	Rank correlation
Year 1	0.603	-0.01	0.809	-0.70
Year 3	0.739	0.06	0.801	-0.30
Year 6	0.768	0.29	0.856	0.60
Year 10	0.775	-0.20		

Notes: Table I shows summary statistics and rank correlation coefficients for hedging effectiveness, as defined by the coefficient of determination of the regression:

$$RS_t = \alpha + \beta RF_t + e_t,$$

where the spot (futures) return RS_t (RF_t) are defined as logarithmic price changes and are defined for hedging periods of five, ten and 20 days. The number of observations are 15, 12, 8 and 5 for the first, third, sixth and tenth year, respectively.

We next test the hypothesis that a contract will be more successful if it provides maximum correlation with the unhedged risk in the economy. Following Ederington (1979) and Tashjian, Johnston and McDonnell (1989), we define ‘hedging effectiveness’ as the percentage reduction in variance obtained with the minimum variance hedged portfolio. Ederington (1979) shows that this quantity can be estimated by the coefficient of determination of the regression:

$$RS_t = \alpha + \beta RF_t + e_t$$

where the spot (futures) return RS_t (RF_t) are defined as logarithmic price changes and are defined for hedging periods of five, ten and 20 days. To avoid rolling over contracts around expiration days, we dropped the expiration month and used the remaining eight months of the selected years for our regression.

The measures of hedging effectiveness were computed for the entire sample, as well as for those contracts that have been trading for ten years or more, and are summarised in Table I. Not surprisingly, hedging effectiveness for the latter group is higher than for the overall sample that includes winners and losers.

Moreover, this difference stands out from the first year on. Hence, the more successful contracts clearly serve their purpose by providing effective risk reduction. At the same time, proper contract design does not guarantee success, as can be seen from the low rank correlations that relate futures volume and hedging effectiveness. Note finally that hedging effectiveness increases with the length of the hedge, as the relative benefit of a reduction in variance through the hedge increases with time.

4.2 Competition

A futures contract's success is likely to be affected by the existence of competing contracts. Consider first the creation of duplicate contracts by rival exchanges. Cuny (1993) shows that a first-mover advantage exits since traders are attracted to the liquidity offered by the established market. Second contracts may not be able to divert trading from the existing market and hence fail to gain a critical market share, unless: i) markets are segmented (eg investors may prefer to use a domestic market or be restricted from using a foreign market); ii) trading hours are different; and/or iii) market structure and regulatory differences exist. If successful, a second contract may benefit the first mover if it creates additional trading possibilities (eg by extending trading hours, or by creating arbitrage possibilities). But, it may also hurt the first mover, if its presence results in the loss of market share and liquidity by the former. Likewise, an exchange may succeed in offering correlated contracts if they correspond to agents' different hedging demand and sensitivity to transaction costs. For example, Tashjihan (1995) show that an exchange may decide to bundle contracts and sell the package at a lower fee to hedgers with small, but diversified holdings for whom purchasing all the individual contracts would be too expensive.

But competition from different instruments or market systems could also have a complementary effect. For example, the creation of option contracts may further enhance the liquidity of related futures contracts by increasing hedging demand for the futures contract (eg to cover option positions), and by generating new arbitrage and speculative trading possibilities. In this context, Merton (1992) suggests that financial innovations are part of a spiral effect, that will ultimately lead to more efficient capital markets and a more efficient intermediation system. He argues that new exchange-traded instruments (such as futures and options contracts) foster the development of customised, over-the-counter instruments. These in turn require the issuing institution to hedge its exposure by using standardised contracts, which will result in higher liquidity and lower marginal transaction costs in these standardised contracts. Exchanges, encouraged by these developments, will then be inclined to innovate further.

We test whether competition both in the sense of a dually listed contract, or an option on the futures, has a determining effect on a contract's success. As explained in Appendix B, this is done by inserting dummies in the panel specification.

Our results reported in Table H confirms the first-mover advantage, in that its coefficient is positive and significant. Competition from contracts with same trading hours has a positive, but insignificant effect on volume. Competition from contracts with non-overlapping trading hours is significantly negative. Taken together, these results may indicate that the first-mover advantage (in this case held by foreign exchanges) dominates possible complementary trading effects of a second contract, as suggested earlier. Finally, Table H shows that options have a negative, but insignificant effect on futures volume. This suggests that exchange-listed options are not instrumental in creating additional trading opportunities in the futures markets.[19]

(19) Because of data constraints, the option dummy reflects the availability of exchange-listed options only.

5 Conclusion

In our overview of futures innovation on LIFFE, we have identified a number of interesting patterns. Futures activity, measured by either volume, open interest or value, shows considerable heterogeneity across contracts. Contract success cannot easily be inferred from the contract's first years of trading. Most LIFFE contracts, do, however, reach conventional benchmarks within their first three years of trading.

Consistent with the theoretical literature on incomplete markets, we find that futures volume is correlated with the size of the underlying market, as well as with its volatility. Both can be seen as proxies for existing hedging demand. We further confirm the existence of a first-mover advantage, in that LIFFE's own creations have higher trading volumes than duplicate contracts.

When measuring trading costs in the different futures markets, we find that there is little systematic correlation between bid-ask spreads and futures volume. This suggests that there may be a critical level of trading activity beyond which bid-ask spreads and execution risk vary relatively little. We conclude that liquidity seems to be a consequence rather than a cause of contract success (or lack of liquidity a cause of failure).

Appendix A: data

A.1 Futures data

Daily volume and open interest, and daily and intra-day price data on futures traded at London International Financial Futures Exchange (LIFFE) (source: LIFFE).

Most of our analysis of activity in the futures market was done using volumes data (ie numbers of contracts traded). A drawback of this approach is that futures vary in contract size and hence when comparing across contracts we are not comparing like with like. For this reason a value measure is often preferable (see Barclay (1994)). We adopted this approach where it was not necessary to convert the values into a single currency, ie when computing ratios or when ranking. However, where conversion would have been necessary we decided that the advantages of a value measure would have been outweighed by the disadvantages of conversion: it would have been impossible to distinguish between 'real' growth and 'exchange rate related' growth. Furthermore, as we were only examining the futures of one exchange it was reasonable to assume that the contract sizes were optimally chosen by the exchange and were adapted to the trading practice of the particular spot markets. Hence, on balance we decided that it would be preferable to use volumes data where we wanted an absolute measure of activity.

A.2 Spot data

Eurotrack 100 index: daily price data (source: Datastream); monthly market capitalisation data and turnover data (source: London Stock Exchange).

FT-SE 100 index: daily price data (source: Datastream and London Stock Exchange); daily FT-All share market value data used as a proxy for market value (source: Datastream); daily equity turnover (£) (source: Financial Times).

Three-month Eurocurrency markets: daily interest rates rates at 5pm each day (source: Datastream); quarterly market value data (source: International Banking and Financial Market Developments, Bank of International Settlements (Tables 4a and 4d)). The market value was calculated from banks' cross-border and local positions in foreign currencies: an average amount outstanding of assets and liabilities was calculated for each year. The data were then converted into domestic currencies using average exchange rates (source: Financial Statistics, table 7.10A).

Three-month Sterling deposit market: daily inter-bank rate (source: Datastream); UK banks' quarterly sterling deposits with other UK banks (source: Bank of England). (This excludes CDs which are only available from 1986).

Three-month ECU deposit market: daily deposit rate in London (source: Datastream); quarterly market value data (source: Bank of International Settlements).

Ecu bond: daily price of International Securities Market Association ECU bond index for maturity over five years (source: Datastream).

Spanish Government bond: daily price and market value of Spanish Government All-trade index, seven-ten years (source: Datastream). *An annual average market value was calculated.

German Government bond: daily price and market value of German Government All-traded index, three to five years and seven to ten years (source: Datastream). *An annual average market value was calculated.

Japanese Government Bond: daily price and market value of Japanese Government All-traded index, seven to ten years (source: Datastream). *An annual average market value was calculated.

US Government Bond: daily price and market value of US Government All-traded index, over ten years (source: Datastream). *An annual average market value was calculated.

Italian Government Bond: daily price and market value of Italian Government All-traded index, over ten years (source: Datastream). *An annual average market value was calculated.

UK Government Bond: daily price and market value of UK government All-traded index, three to five years and over ten years (source: Datastream). *An annual average market value was calculated.

(* The prices are calculated by taking the closing prices of the constituent bonds.)

Appendix B: panel data estimation procedure

To determine the relative importance of the various determinants of contract success, we consider panel data with the change in quarterly futures volume ($DFVOL_{it}$) as the dependent variable. Because of data availability constraints, quarterly data were used for eleven contracts.[20] This includes both actively traded contracts, and contracts that have been delisted as of October 1994. Our sample spans the years 1982-1994, but the number of quarters differs among contracts because contracts were introduced at different times. Hence our panel is unbalanced. A contract is included in the panel the first full quarter it is trading. For example, a contract that was listed in May 1990 will first appear in the panel in the third quarter of 1990.

The main explanatory variables are changes in quarterly spot market capitalisation (*DSVOL*) and changes in spot market volatility (*DSVOLAT*). Volatility is defined as the quarterly average of daily closing price changes: $\log(C_t/C_{t-1})$.

The following set of dummies is used in the regression: *D0* = 1 if the contract has an option; *D1* = 1 if the contract was a first-mover contract; *D2* = 1 if a cross-listed contract exists with overlapping trading hours; *D3* = 1 if a cross-listed contract exists with non-overlapping trading hours. Dummies take on the value one the first full quarter after the event (eg the creation of an option) took place.

The panel data specification looks as follows:

$$DFVOL_{it} = \alpha + \beta_1\, DSVOL_{it} + \beta_2\, DSVOLAT_{it} + \beta_3\, D_{it} + w_{it}.$$

The model is estimated as a panel with common intercept and coefficients, using OLS with White heteroskedasticity consistent standard errors. An alternative specification where errors are allowed to vary across contracts (random effects model) was found to yield similar qualitative results, and has not been reported.

(20) The contracts included were the long gilt, T-bond, short sterling, euroecu, euromark, euroswiss, eurolira, bund, jgb, Italian government and the FT-SE 100.

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