

# The Material Production of Virtuality: Innovation, Cultural Geography, and Facticity in Derivatives Markets

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## ***The Material Production of Virtuality: Innovation, Cultural Geography, and Facticity in Derivatives Markets***

### ***Abstract:***

In the existing literature, the ‘virtual’ nature of financial derivatives is often commented upon. This article analyzes the development since 1970 of organized financial-derivatives trading in the U.S. and U.K. (in particular, derivatives exchanges and the British financial spread-betting industry) with the goal of examining the material production of virtuality. The article explores the similarities and differences between technological innovation and innovation in derivatives; discusses the role of the ‘internal’ cultures of financial markets and of the wider culture (in particular, the legal traces of hostility to gambling); and analyzes the requirement of ‘facticity’ for the price of the underlying asset (or level of the underlying index or interest rate).

Key words: financial derivatives; financial innovation; social studies of finance; futures; spread betting.

A dominant feature of the massive changes in global financial markets since 1970 has been the huge growth in trading of financial derivatives: contracts or securities the value of which depends on the price of another 'underlying' security or on the level of an index or interest rate. The limited financial-derivatives trading that existed at the start of the 1970s was primarily ad hoc, conducted either in the interstices and/or on the fringes of stock markets, or else 'over-the-counter': by direct negotiation between organizations, especially banks. In January 1970, no organized financial-derivatives exchange existed anywhere in the world.

At the end of June 2005, exchange-traded derivatives totalling \$58.5 trillion (the equivalent of around \$9000 for every human being on Earth) were outstanding worldwide, a four-fold increase since as recently as June 1998 (see figure). True, many of these derivatives contracts will have been entered into to offset the risks of other derivatives (so an unknown proportion of the total is thus in a sense self-cancelling), but the change from 1970 is nonetheless striking.

The emergence of financial-derivatives exchanges and the fast growth of the over-the-counter market have led to considerable comment. Economists have focused primarily on the pricing of derivatives (although there is a more 'institutional' literature in economics on financial innovation: see Tufano 2003). Recently, the attention paid to derivatives by human geographers, anthropologists and sociologists has increased sharply: see, for example, Tickell (1998 & 2000), Pryke and Allen (2000), Maurer (2001 & 2002), LiPuma and Lee (2004 & 2005) and Arnoldi (2004). A common theme in this more sociological literature is 'the strangely imaginary ... or virtual character of derivatives' (Arnoldi 2004: 23). A security such as a stock or a bond is already an abstract claim. A derivative of such a security is thus an abstract claim on

an abstract claim, and ‘derivatives of derivatives’ further extend the chain of abstraction.

Virtuality, however, is always a material effect, indeed an elaborate, sophisticated and expensive one, and materiality is rightly the subject of growing attention in the social sciences (see, e.g., Miller 2005 and the work cited therein). In the existing literature on derivatives, an emphasis on their virtuality rightly sits alongside a sense of their real-world importance. Derivatives are ‘complex and virtual’, write LiPuma and Lee (2004: 33), but ‘it is impossible to grasp the character and influence of global flows of capital without a knowledge of how they operate within a culture of financial circulation’. However, the processes of the material production of virtuality have received scant attention in the geographical, anthropological or sociological literature on derivatives (one of the few exceptions is Millo, Muniesa, Panourgias and Scott 2005).

In order to help develop an understanding of the material production of virtuality, this article explores three issues that have so far received insufficient attention. The first is the parallels (and also the dissimilarities) between financial innovation and technological innovation in other spheres. This theme *is* in the literature in economics (e.g. Silber 1981), but the view of technological innovation to be found there is too narrow, excluding for example its political dimension. Viewing derivatives as innovations offers not only a perspective on the ‘performativity’ of economics (Callon 1998; MacKenzie and Millo 2003; MacKenzie 2004) but also highlights issues such as the balancing of interests and intellectual property regime involved.

The second issue to be explored is the ‘cultural geographies’ (Thrift 2000) of derivatives. With the exception of Maurer’s work on ‘Islamic’ derivatives (Maurer 2001; see also Maurer 2005), the existing literature is somewhat homogenizing, seeming implicitly to posit a world in which, at least within its metropolitan core, ‘place’ no longer matters greatly. Spatial and cultural location is still significant, however, even in the metropolitan heartlands. The differing ‘internal’ cultures of financial markets have left their stamp, as have the different manifestations of a pervasive cultural theme: the relationship between investing and gambling (de Goede 2005).

The third issue to be discussed is ‘facticity’. The virtual character of a derivative contract is enhanced if, as is increasingly the case, it can be settled only by the transfer of cash, with neither party able to demand or impose delivery of an underlying asset. However, cash settlement requires that the price of the asset, or the level of the index or rate underlying a derivative, be a ‘fact’: it must be known, intersubjectively valid, and an acceptable representation of the reality of which it speaks.

The article’s empirical focus is the development of financial-derivatives exchanges in the U.S. and U.K. since 1970 and the emergence of the British financial spread-betting industry. The specificity of exchanges and of spread-betting builds into the study a certain bias towards the discovery of heterogeneity: national differences in over-the-counter trading almost certainly exist, but would be harder to identify. That bias, however, is balanced by the choice of the U.S. and U.K. as comparator countries. Their overall financial systems have very similar contours, and in the literature on ‘varieties of capitalism’ (e.g. Hall and Soskice 2001) they are normally lumped

together. The differences found between derivatives trading in the U.S. and U.K. are thus differences between two otherwise similar cases. Greater heterogeneity would likely have been found had the study encompassed the financial-derivatives exchanges now thriving in locations as diverse as Frankfurt, Stockholm, Sao Paolo, and Singapore, or those emerging in many other countries, such as Russia and the People's Republic of China.

This article has five sections. After this introduction are three sections devoted to the themes of innovation, cultural geography and facticity. The fifth section is the article's conclusion. Because the article is organized analytically, a brief introduction to the main organizations covered and relevant chronology may first be helpful. The initial modern effort to begin organized financial-derivatives trading was the currency futures launched by the New York International Commercial Exchange in 1970. (A 'future' is a standardized, exchange-traded contract that commits one party to buy, and the other to sell, a set quantity of a given asset at a given price at a set future time.) That effort failed, but currency futures launched by the Chicago Mercantile Exchange's International Monetary Market in 1972 succeeded, as did the Chicago Board Options Exchange, spun off by the Chicago Board of Trade in 1973. (An option gives the right, but unlike a future does not impose the obligation, to buy – or in an alternative form of the contract, to sell – an asset at a set price on, or up to, a given date.) The Chicago Board of Trade itself, and a number of other U.S. exchanges, also began trading financial derivatives in the mid-1970s.

The International Commercial Exchange, Chicago Mercantile Exchange and Chicago Board of Trade had all originally been agricultural commodities exchanges. In the U.K., the eventually most successful financial-derivatives exchange – LIFFE, the

London International Financial Futures Exchange – was an entirely new development, established in 1982. In 1978, the London Stock Exchange set up a Traded Options Market, which merged into LIFFE in 1992. In 1991, the London Futures and Options Exchange (as the London Commodity Exchange was then known) launched property and housing derivatives; it too merged into LIFFE, in its case in 1996. Financial spread betting began with bets on the FT(Financial Times)-30 share index offered by the bookmaker Joe Coral, and gained momentum with the establishment in 1974 by Stuart Wheeler of IG (Investors Gold) Index. In 1981, IG Index began to offer spread bets on the FTSE(Financial Times-Stock Exchange)-100 and Dow Jones indices. Another firm, City Index, began offering financial spread bets in 1983, and others such as Cantor Index have joined the industry more recently.

In analyzing these developments, the article draws upon three sets of sources. The first consists of existing histories of the Chicago Board of Trade (Falloon 1998), Chicago Mercantile Exchange (Tamarkin 1993; Melamed and Tamarkin 1996) and LIFFE (Kynaston 1997). The second is a set of oral history interviews conducted by the author with the interviewees listed in the appendix. The third is the trade press, which is often valuable in particular for revealing failed initiatives in derivatives trading.

Even the most ‘critical’ analyses of derivatives tend to focus on trading that is successful in achieving large trading volumes. Equally interesting analytically, however, are the many cases in which derivatives trading has failed. Perhaps the most important overall example is derivatives of housing, commercial property and land. These assets account for wealth comparable in magnitude to the totality of stocks or bonds, yet the market in derivatives of them is still small (unless mortgage-backed

bonds are regarded as derivatives: I follow market usage in regarding futures and options on mortgage-backed bonds as derivatives, but not the bonds themselves.) For example, the Futures and Options Exchange's effort to launch housing derivatives ended in complete failure. Why derivatives trading should succeed in some spheres and fail in others is a question worth asking, even if it cannot be answered fully here.

### ***Innovation***

The vast bulk of today's financial-derivatives trading is in products that did not exist in 1970, and these products, especially those traded on organized exchanges, did not simply 'evolve'. They were *invented*. Indeed today's financial-derivatives exchanges, especially the newly-established ones such as LIFFE, are the result of conscious, deliberate processes of design. It is thus of some interest to compare financial and technological innovation.

Let me begin with similarities. Prior to the nineteenth century, what we now think of as 'science' played little role in technological innovation, but that role has now grown considerably. So too with finance. The academic discipline of economics had little effect on derivatives trading before 1970, but since then its role has been major (MacKenzie 2006).

However, the modern literature on technological innovation (e.g., Barnes and Edge 1982; Fleck 1994; Sørensen and Williams 2002; Oudshoorn and Pinch 2003) has shown the weakness of the still-common 'linear model' in which science 'discovers' truths, technologists 'apply' science by working out its practical implications, and the resultant products 'diffuse' unchanged to users. Instead, the modern literature

suggests that science and technology interact not as disembodied knowledge but as embodied expertise (often via the circulation of people); that science is a resource that engineers draw on creatively, rather than simply applying; that careful attention to users' needs and to 'local practical knowledge' (Fleck 1994) is necessary for successful innovation; and that much innovation – Fleck calls it 'innofusion' – takes place in what is conventionally regarded as 'diffusion'.

All of these aspects of technological innovation also characterize innovation in derivatives: as Callon now puts it, the 'performativity of economics' is a 'coperformance' involving 'economists in the wild' – lay as well as professional – rather than just 'confined' (laboratory or university) economists (Callon forthcoming). Although academic economics has underpinned derivatives trading both technically and by providing legitimacy, especially against the charge of gambling (MacKenzie 2006), key innovations in exchange-traded derivatives have involved Callon's 'economists in the wild', such as Richard Sandor, who left the University of California at Berkeley for the Chicago Board of Trade, and his Mercantile Exchange counterparts Fred Arditti and Rick Kilcollin.

These economists in the wild did not simply 'apply' economics. They found themselves involved in processes of innovation that involved close interaction with the three main categories of users of derivatives: hedgers, who are concerned to protect their organizations against a risk such as currency or interest-rate fluctuations; speculators, who hope to profit by correctly anticipating those fluctuations; and market makers, who stand ready both to buy and to sell the product in question, earning the difference between the 'bid' and the 'ask' (the prices at which they are prepared to buy and to sell).

Hedging, speculating and market making are categories of activity rather than of people and organizations: market makers, for example, often hedge their positions or deliberately take speculative positions, while some well-publicized derivatives fiascos have resulted from organizations starting out by hedging but slipping into speculating. Nevertheless, the categories of ‘hedger’ and ‘speculator’ are part of the ‘lay sociology’ that participants in derivatives exchanges deploy, and ‘market maker’ is a designated role with specific responsibilities.

To neglect any of these categories of user when innovating could be fatal. For example, the International Commercial Exchange’s currency-futures trading overlapped with the start of the break-up of the Bretton Woods system of fixed exchange rates, a favourable time because volatility encourages derivatives trading by giving hedgers, speculators and market makers incentives to participate. However, insufficient effort seems to have been devoted to designing and marketing contracts that satisfied the needs of hedgers. ‘[T]he contract specifications had to be attractive to bank traders and corporate treasurers. ... Successful futures contracts need, at a minimum, 20 to 25 percent commercial participation. You cannot have a market just for speculators’ (Melamed and Tamarkin 1996: 174).

The specifications of exchange-traded derivatives include: trading hours; contract size; ‘tick’ size (the minimum unit of price); limits (if any) on daily price moves and on maximum positions; requirements for ‘margin’ (the sums participants in an exchange have to deposit with the exchange clearinghouse when they first buy or sell a derivative, and then have to adjust as prices fluctuate); expiration dates; and

procedures for delivery of the underlying asset or for cash settlement.<sup>1</sup> Successful choice of such specifications involves careful attention to the sometimes-conflicting interests of exchange members and external customers (whether speculators or hedgers), and of ‘the ‘longs’ who have bought a derivative and the ‘shorts’ who have sold it. These interests are neither easy to determine – extensive research often seems to be necessary to elicit them, giving contract design something of the flavour of economic experimentation (q.v. Muniesa and Callon forthcoming) – nor fixed. Indeed, a major entrepreneurial activity of financial-derivatives exchanges is to persuade external customers (and sometimes also exchange members) that it is in their interests to trade a new derivative.

The potential for interests to conflict, even after they have been elicited and ‘translated’ (Latour 1987) in this way, makes contract design – like technological design (Winner 1980) – an inherently political problem. It is one that cannot be solved simply by fiat (overly favouring the interests of one group will likely be fatal, because others will then not participate in trading), but requires balance and compromise. Richard Sandor, for example, noted that the delivery procedure he designed for the Chicago Board of Trade’s first financial derivative, futures on mortgage-backed bonds, ‘is complicated and cumbersome. It appears to cause difficulties for both the longs and the shorts. It is in that sense fair, and may be the reason it has been successful’ (Sandor and Sosin 1983: 267).

Design, marketing and the encouragement (often via face-to-face meetings) of participation are pressing matters, especially in the early days of a new contract,

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<sup>1</sup> See, e.g., Sandor and Sosin (1983: 260).

because exchange-traded derivatives are subject to ‘virtuous’ and ‘vicious’ circles akin to those identified in technological innovation by Arthur (1984) and David (1992).

The archetypal example is the QWERTY keyboard. It is not demonstrably optimal for electronic word-processing – its original motivation was to reduce the chances of the levers of a mechanical typewriter sticking together by minimizing the frequency with which adjacent keys were struck in succession – but QWERTY is ‘locked in’ and its rivals ‘locked out’: none has a realistic chance of displacing it.

In derivatives trading, a high volume of trading means liquidity (even large transactions can be conducted quickly, easily, and without a large impact on price), low transaction costs and a robust market price, conditions which make trading attractive to both hedgers and speculators. Conversely, low volumes mean illiquidity, high costs and unreliable prices. So an exchange that gains an established position in a particular derivative becomes, like QWERTY, hard to challenge (Silber 1981: 132). LIFFE, for example, found that the currency futures it launched in competition with those of Chicago Mercantile Exchange were not successful, despite London’s overall prominent role in foreign exchange (Kynaston 1997: 95-96 and 126-27; Leslie and Wyatt 1992: 91). Instead, LIFFE’s survival and success came to rest on derivatives that had no well-established rivals, notably FTSE-100 futures and U.K. and German bond futures.

There are, however, also differences between financial and most technological innovation. The tax treatment of derivatives is more critical to their success than in most technologies. For example, the appeal of the London Traded Options Market to customers was initially limited by the way in which options were treated until September 1980 in U.K. tax law as ‘wasting assets’, which had the consequence that

capital gains tax liabilities could be incurred on loss-making as well as on profitable trading (Steen 1982). In contrast, a large part of the appeal of financial spread betting is that in the U.K. customers' winnings are free from tax. Spread-betting firms incur tax liabilities as bookmakers, but these are modest and absorbed into the spread between the prices at which the firms buy and sell contracts.

Financial innovations are easier to 'reverse engineer' than most technologies (Tufano 1989: 230; Allen and Gale 1994: 53). To minimize the risk of dispute and litigation, the specification of derivatives has to be made as explicit as possible. Trading derivatives, pricing them and hedging their risks may require tacit knowledge, but their design is easy to copy. Innovative technologies (especially those that *are* easily copied, such as pharmaceuticals) are protected from imitation by intellectual property law, particularly patenting. In contrast, the legal protection of innovative financial products (and, for example, derivatives pricing models) in both the U.S. and U.K. has been limited, at least until very recently. In the U.S., for example, financial products and models were presumed to fall within the 'business method' and/or 'mathematical algorithm' exemptions from the possibility of patenting. The general shift of intellectual property law from a presumption of open access – to which *patents* were the exception – towards a presumption in favour of private property (Merges 2000) has only quite recently encompassed financial innovations.

A pivotal case was *State Street Bank & Trust Co. v. Signature Financial Group*.<sup>2</sup> It concerned U.S. Patent 5,193,056 (9 March 1993), assigned to Signature, which covered a data processing system for calculating asset values and allocating

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<sup>2</sup> U.S. Court of Appeals, Federal Circuit, 149 F.3d 1368.

expenses in a ‘hub and Spoke’™ system in which mutual funds share the ownership of a common investment portfolio. State Street had sought to have the patent ruled invalid, but in July 1998 the Court of Appeals for the Federal Circuit found in favour of Signature. State Street sought to appeal to the Supreme Court, but in January 1999 the latter denied it leave to do so (Lerner 2002: 903).

It is remarkable that, at least until *State Street*, financial derivatives, central as they are to the global capitalist system, developed in a legal regime with only limited intellectual property rights. Did that regime (a) slow innovation by reducing incentives, or (b) enhance innovation by facilitating copying and adaptation in a context in which QWERTY-like ‘first mover’ advantages were an adequate incentive? That question points to a familiar debate about patenting that cannot be entered into here, but the extraordinary pace of derivatives innovation might incline one to (b). What is, however, clear is that copying was indeed easy. Specific derivatives have frequently been imitated without, at least until recently, fear of litigation. IG Index would, likewise, have been unable to prevent other firms offering analogous spread-betting contracts. Indeed, there is a sense in which entire exchanges have been imitated. LIFFE, for example, was more closely modelled on the Chicago exchanges, particularly the Mercantile Exchange, than on any British precedent (Kynaston 1997; Leslie and Wyatt 1992: 91).

### ***Cultural Geography***

The establishment of LIFFE highlights a theme prominent in ethnographies such as Abolafia (1996): trading is a cultural as well as an economic activity. The Chicago financial derivatives markets inherited from their parent agricultural futures exchanges

a tradition of often-frenzied open-outcry trading conducted in ‘pits’ (stepped amphitheatres), accompanied by frequently jostling and occasional fist-fights. Chicago’s was a trading culture quite different from that of the New York Stock Exchange: there was no equivalent amongst Chicago’s competing market makers of New York’s ‘specialists’, who enjoyed what in Chicago was often perceived to be unfairly privileged access to the ‘book’ of unfilled orders (in return for an obligation to maintain an orderly market, in particular to trade with their own capital if there was a temporary imbalance between orders to buy and to sell).

And Chicago’s rough and tumble was a world away from the ‘gentlemanly capitalism’ (Thompson 1997) that played a dominant role in London until the early 1980s (the ‘Big Bang’ deregulation of 1986 was a key moment in its demise). It is easy to stereotype – to forget that an urbane self-presentation is perfectly compatible with dedication, financial acumen, and even hard-edged dealing – but nevertheless the elite of London’s financial sector formed something of a ‘status group’ in Weberian terms. One interviewee nicely expressed the difference he saw between its ethos and that prevalent in the U.S.:

They [Americans] are much keener to make money than [we] are here ...

When I was young, if you’d been to a public school, and particularly if you’d been to Oxford or Cambridge, you really didn’t need to worry much more about anything else as far as social status was concerned. You could go anywhere and you’d be accepted anywhere. You knew where you were (Steen interview).

Established social standing made it possible to disdain small-minded pursuit of pecuniary advantage, which was sometimes called ‘tizzy snatching’ (‘tizzy’ was nineteenth-century English slang for a sixpence): ‘people trading and taking a snatch at

profit of sixpence a share' (Steen interview). In Chicago, in contrast, the equivalent of a tizzy was considered well worth snatching energetically.

LIFFE plumped unequivocally for Chicago culture over gentlemanly capitalism, opting symbolically for Chicago's brightly-coloured trading jackets rather than the dark suits and black shoes traditional in the City. (LIFFE drew the line only at Union Jack jackets, fearing they 'would be seen on television selling the pound down the river' [Kynaston 1997: 73].) LIFFE's traders were often defiantly East End or 'Essex boys' (Zaloom 2003: 268) rather than gentlemen.

The London Traded Options Market (LTOM) was far more ambivalently placed than LIFFE. Its inspiration too was Chicago (in its case, the success of the Chicago Board Options Exchange, although the immediate spur to its establishment was the threat that options on London shares might be traded in Amsterdam), but LTOM's London Stock Exchange parentage was too strong for it fully to embrace the more flamboyant aspects of Chicago trading culture. One market maker who moved from Chicago to LTOM in 1986 recalls that he 'was booed off the floor first day because I had brown shoes on'. His colleagues were no doubt teasing, but he found the attempt to translate Chicago attitudes and practices to London sometimes uncomfortable (Wenman interview).

LTOM had some notable successes – for example giving birth to the now-dominant U.K. share index, the FTSE-100, as the basis for index options – but there were also economically consequential tensions with its parent. For instance, stock-exchange 'jobbers' (market makers) valued their right not to disclose large transactions for 90 minutes, because it made it easier to handle big blocks of shares,

but this caused difficulties to options market makers who could never be entirely certain of the price at which they could hedge an options position. No equivalent right to delayed disclosure existed in the U.S., and the difference was probably one factor leading options trading in the U.K. not to reach volumes equivalent to those in the U.S. The bid-ask spreads quoted by LTOM market makers seem to have tended to be wider than in the U.S., which helped insulate them against risk but inhibited the market's growth.

The wider culture in which derivatives markets are embedded can also be consequential. In both the U.S. and U.K., a crucial aspect of this was the 'trace' left in the legal system by nineteenth- and early-twentieth century hostility to gambling. Section 18 of the U.K. Gaming Act of 1845 laid down 'That all Contracts or Agreements ... by way of gaming or wagering, shall be null and void', rendering gambling debts unrecoverable in law. The U.S. went further, with most states (including, crucially from the viewpoint of the Chicago derivatives markets, Illinois) outlawing gambling.

Futures markets in agricultural and other physical commodities in the U.S. and U.K. were kept from the scope of the gambling laws by what became known as the 'intent test' (Swan 2000: 212-13). If the parties to a derivatives contract intended the delivery of the asset in question, then the contract was not a wager, and it was legal and enforceable (even if delivery was in actuality rare). Conversely, the intent test meant that a court in either the U.S. or U.K. would most likely rule that a derivatives contract that could be settled only in cash was a wager. The consequence was that although the Chicago exchanges had wished to introduce futures on stock indices from

the late 1960s onwards, they were unable to do so until 1982. (How the necessary legal and regulatory changes were brought about is discussed in MacKenzie 2006.)

In England, LIFFE faced the same issue, initially in regard to interest-rate futures based upon LIBOR, London Interbank Offered Rate (see below). It devised a hybrid: cash settlement, but with the 'long' having the right to demand delivery of a deposit. In July 1982, LIFFE obtained Counsel's opinion that 'such a contract is not a wager in law' (Kynaston 1997: 58). In 1984, a similar hybrid was devised for LIFFE's new FTSE-100 futures, again because of the fear that 'Gaming Act implications might preclude cash-only settlement' (Kynaston 1997: 131). The issue was resolved decisively only in 1986, when, Kynaston reports, LIFFE's 'traditionally good relationship' (1997: 155) with the Department of Trade and Industry led to the inclusion in the Financial Services Act of a provision (section 63) laying down that no contract that constituted investment business within the meaning of the Act could be rendered 'void or unenforceable' on the grounds that it was a wager.

The provision had an inadvertent consequence: it rescued the nascent British spread-betting industry (which has subsequently grown to compete with LIFFE for the business of individual customers) from the consequences of the 1987 stock market crash. Because gambling remained legal in the U.K., IG Index had been able to turn the analogy between derivatives trading and gambling from a problem (as it had been in the U.S. and for LIFFE) into a resource: making a derivative into a bet confers the tax advantage noted above.

The standardized contracts that IG Index and its competitors offer their customers are analogous to futures (the main difference is that the contracts are

directly with the spread-betting firm, rather than between customers). In the case of FTSE-100 contracts, for example, firms quote a price at which customers can 'buy' the index, and a lower price at which they can 'sell' it. (As with market makers on exchanges, the firms' profits come mainly from the spread between the two prices.) A customer who believes the index will rise will buy the index, staking a certain amount (typically of the order of £5) per index point, hoping that the index will have risen by more than the spread by the time he or she sells the index back to the firm. A customer who believes the index will fall will begin by selling the index, and close the bet by buying (see, e.g., Vincent 2002).

As with exchange-traded futures, spread bets thus offer the potential that a limited initial 'margin' deposit can become a much larger gain or loss. Spread betting firms hedge any large resultant exposure to market movements by taking a position similar to that taken by the aggregate of their customers (often using futures on LIFFE or other exchanges). Until 1986, however, it was impossible legally to recover sums customers owed the firm. IG Index controlled that risk by requiring a deposit large enough to cover likely losses, but calculating that deposit involved estimating the size of plausible market movements.

As noted in MacKenzie (2004), the 1987 crash involved a market move far greater than seemed likely. IG Index, at that time nowhere near as well-financed as it is today, could easily have become insolvent. Because its customers were in aggregate 'long', it too was long, and huge price declines meant it owed large sums to its brokers, which had to be paid immediately. However, many of its customers (who thought they knew gambling debts to be unenforceable) refused, or were unable, to pay what they owed IG Index. Fortunately from its viewpoint, IG Index was able to

point them to section 63 of the Financial Services Act, which meant they had to pay (Wheeler interview).

### ***Facticity***

‘Culture’ is thus not simply ‘the context’ within which derivatives trading takes place. Via matters such as the law of gambling, it shapes and is intermeshed with the detailed mechanics of this trading. Another key aspect of those mechanics is the nature of the asset underlying a derivative.

For agricultural futures exchanges – which were, as noted, the sites from which modern financial-derivatives exchanges sprung – the most pressing issue in this respect was standardizing the underlying asset to an extent sufficient for claims on it to be tradeable without reference to any *specific* physical entities. In Chicago grain trading, standardization seems to have been an emergent property, co-evolving with futures trading (Cronon 1991). Later, standardization was an explicit part of the planning for a new contract, such as the Chicago Board of Trade’s futures on mortgage-backed bonds or its futures on Treasury bonds, introduced in August 1977 and ‘the exchange’s most successful contract ever’ (Falloon 1998: 251). Bonds themselves could not plausibly be standardized, so in both cases the tricky problem of making different issues of bonds commensurable had to be tackled. The solutions found were a little elaborate but robust, though sudden shortages of the ‘cheapest-to-deliver’ bond are a recurrent problem of which all sophisticated bond-derivatives traders must be wary.

A derivatives contract that can be settled only in cash avoids such problems, and cash settlement also facilitates the development of derivatives on more abstract entities (such as stock indices) that cannot straightforwardly be delivered. However cash settlement raises a difficulty of a different sort (one quite distinct from the legal vulnerability arising from the ‘intent test’). The price, index level or interest rate used to determine cash settlement sums must be *facts*: they must, for example, adequately represent the risk that hedgers wish to offset.

That, for example, seems to have been a factor in the failure of the London Futures and Options Exchange’s property futures. Its housing futures, for instance, were based on the Nationwide Anglia Building Society house price index. The achievement of facticity in the sense of representativeness was undercut by the slow processes of house sales in the U.K., by the tendency for price movements in other parts of the U.K. to lag behind London by six to twelve months, and by the impossibility of replicating for housing the arbitrage (described in MacKenzie 2004) that keeps stock-index futures tied to the underlying index (Patel 1994). Spread betting firms have also launched housing contracts, but they too have had problems with the issue of index representativeness. In 2006, the Chicago Mercantile Exchange launched housing futures and options on Case-Shiller Indexes®, which are based on the possibly more robust device of identifying repeat sales of the same property.<sup>3</sup> (Their developers include the leading economist Robert Shiller.) It will be interesting to track whether more sophisticated index construction allows the problems of housing derivatives to be overcome.

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<sup>3</sup> I am grateful to Susan Smith for alerting me to the launch of these futures.

Other aspects of facticity are that a fact must not be manipulable by those with interests at stake, and must not give rise to dispute or litigation. The ‘trace of authorship’ of a financial fact need not disappear as it tends to in the case of a scientific fact (Latour and Woolgar 1986: 82), but authorship must not be problematic.

How unproblematic authorship is achieved in the single most important set of facts, London Interbank Offered Rate (LIBOR), is instructive. Around half<sup>4</sup> of the total amounts of outstanding derivatives contracts worldwide are indexed to LIBOR, which is the basis of both exchange-traded contracts, such as the Chicago Mercantile Exchange’s Eurodollar contract or LIFFE’s Short Sterling interest-rate contract, and also of interest-rate swaps, which, measured by amounts outstanding, are by far the dominant contracts in the over-the-counter derivatives market. In a typical swap, party A pays party B a rate of interest that is fixed for the contract’s duration, while B pays A a floating rate, most commonly LIBOR.

With contracts totalling around \$150 trillion (over \$20,000 for every human being on Earth) thus indexed to LIBOR, its facticity is thus of some consequence. Measured by the amounts of money resting directly upon it, LIBOR is arguably the most important set of numbers in the world, but, surprisingly, it has never, to my knowledge, been the object of a social-science study (the only detailed source on it is unpublished: Mason 1999).

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<sup>4</sup> Greater precision is unfortunately impossible, because derivatives data from the Bank for International Settlements do not specify the rate underlying interest-rate derivatives.

Loosely, LIBOR is the interest rate at which major banks can borrow funds from other banks in the London interbank market in a particular currency for a given period of time. (Because a range of currencies and time periods are involved, LIBOR is a set of numbers – six-month U.S. dollar LIBOR, for instance – not a single number.) For certain purposes a broad definition of this kind is adequate: experienced participants in the interbank market would be able, with reasonable confidence, reliability and precision, to give a LIBOR figure, and consulting a number of such participants would iron out any idiosyncratic figures.

Informal processes of estimating LIBOR were, however, obviously vulnerable to dispute, and gradually were replaced by more formal ‘fixing’ procedures. When it launched its Eurodollar futures in December 1981, the Chicago Mercantile Exchange set up its own daily bank-polling mechanism, designed by its chief economist, Fred Arditti. ‘[I]n the beginning there [was] some minor grousing’, says Leo Melamed, then chair of the Exchange, but ‘the beauty of the [LIBOR] “fixing” was that it was so overwhelmingly accepted as the “true” price for interest rates’.<sup>5</sup>

In 1985, the British Bankers Association, membership of which is open to international banks trading in Britain as well as British-domiciled banks, introduced a centralized daily LIBOR ‘fixing’ (similar in outline to Arditti’s) that eventually replaced all other fixings, although other ‘LIBORs’ are still sometimes quoted. The Foreign Exchange and Money Markets Advisory Panel of the Association selects panels of eight, 12 or 16 banks for each currency on the basis of those banks’ ‘reputation’, ‘scale of activity in the London market’ and ‘perceived expertise in the

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<sup>5</sup> Leo Melamed, electronic mail message to author, 13 January 2006.

currency concerned’, while ‘giving due consideration to credit standing’ (Mason 1999: 3-4).

By 11.10 am each business day, each bank on a LIBOR panel reports to Telerate (now part of Reuters) ‘the rate at which it could borrow funds [‘unsecured’, and ‘governed by the laws of England and Wales’] were it to do so by asking for and then accepting inter-bank offers in reasonable market size just prior to 11.00’ (Mason 1999: slides 8 and 9) in the currency and for the time period in question. The rates are then ranked in order, the top and bottom quartiles are ignored,<sup>6</sup> and the mean of the second and third quartiles is calculated. That mean is LIBOR, and by around 11.45 am it is disseminated worldwide via all the main market networks.

The fixing takes inputs that may seem imprecise – ‘we ask *them* [the banks on the panel] to tell us what *other people* are offering’; there is no requirement that any loan actually be taken out at that rate; and what constitutes ‘reasonable market size’ is deliberately not defined exactly (Mason 1999: 4-5, emphases in original) – and from those inputs it produces almost unequivocal facts. The fixing’s elegance is that it is *sociologically* robust, so to speak. The banks that produce the inputs will very likely have large derivatives portfolios indexed to LIBOR, and thus have an ‘interest’ in the final figure, but as well as the latter their inputs are also disseminated. An idiosyncratic, manipulative input would thus be on public display to the market. Furthermore, the exclusion of the top and bottom quartiles means that an overly-idiosyncratic input would in any case be thrown out of the calculation.

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<sup>6</sup> In the Chicago Mercantile Exchange’s LIBOR fixing, only the top and bottom rates were excluded from the calculation (Melamed, electronic mail message, 13 January 2006).

LIBOR is of course a social-kind (Barnes 1983), performative fact: it *is* the output of the above process. The one significant issue about its facticity has concerned not the integrity of the process but its output's representativeness. As worries grew in the 1990s over the creditworthiness of Japanese banks, the rates at which they could borrow increased with respect to their western counterparts. Their inputs into the LIBOR calculation rose accordingly. In panels with only one or two Japanese banks, that would simply place them in the top quartile and outside the averaging process, but, for example, in 1999 seven of the 16 banks in the yen panel were Japanese. Concern surfaced about the impact on LIBOR of the 'yen premium' – or, viewed from a Japanese perspective, 'the European discount' (Mason 1999: 6). Wholesale removal of Japanese banks from the LIBOR panels would have been a very damaging vote of no-confidence, but the need for such a measure was avoided by the gradual stabilization of the Japanese banking system and the introduction of netting agreements that reduced the exposure of counterparties to a bank failure.

### ***Conclusion***

The more theoretically-oriented of the contributions to the geographical, anthropological and sociological literature on financial derivatives have had a tendency inadvertently to replicate the appearance of the products they discuss: they have formed a rather abstract literature on apparently abstract products. However, a market in these products 'is more than a bright idea', says Leo Melamed, who led the Chicago Mercantile Exchange's move into financial derivatives. 'It takes planning, calculation, arm-twisting, and tenacity to get a market up and going. Even when it's chugging along, it has to be cranked and pushed' (Melamed and Tamarkin 1996: 295).

In emphasizing that calculation, cranking and pushing (for some insight into arm-twisting, see MacKenzie 2006), I hope that this article has exemplified the ‘material sociology’ (Beunza, Hardie and MacKenzie forthcoming) characteristic of the emerging field of ‘social studies of finance’ (for which see, e.g., Knorr Cetina and Preda 2005). The material production of virtuality should matter to those who are interested in the ‘big questions’ of the theoretical literature – such as the extent and distribution of risk or the scope of globalization and commodification – because well-grounded answers to those big questions inevitably must involve the apparent detail of material sociology.

The question of spatiality, for example, demands a nuanced answer. Yes, global financial integration is a very real phenomenon; but no, it has not brought about ‘the end of geography’ (O’Brien 1992). LIBOR, for instance, is a global fact; but it is also *London* Interbank Offered Rate. (Why London, and not New York, is a question with answers in the commercial, regulatory and cultural histories of the two financial centres that cannot for reasons of space be discussed.) Spread betting, to take another example, permits rapidly increasing numbers of residents of the U.K. to use the screens and key-pads of their mobile phones to enter into inexpensive derivatives contract on thousands of global assets: the Nikkei index, Brent crude, gold, carbon emissions permits ...<sup>7</sup> The simple operation involved takes less than ten seconds and the contracts are usually confirmed in as little as five seconds. No fully equivalent experience is currently available to residents of the U.S., and such lived experiences of markets are surely consequential.

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<sup>7</sup> See, e.g., <http://www.igindex.co.uk/>

The material sociology of derivatives has many facets that I have been unable to discuss here: for example, how arbitrage ties the prices of derivatives to their underlying asset (but also how it sometimes fails); the roles in trading of bodies, which are material entities par excellence, and of technologies (the sometimes traumatic shift from open-outcry to electronic trading is discussed by Zaloom 2006); the crucial functions of clearing houses (Millo, Muniesa, Panourgias and Scott 2005); the structuring role of systems of regulation; and so on. It is clearly important to extend the analysis beyond the U.S. and U.K. to the world's many other derivatives exchanges, whether established or nascent. The issues of innovation, cultural geography and facticity need addressed also in the context of the over-the-counter market, not just exchange-traded derivatives. Nevertheless, I hope that this preliminary analysis indicates at least that the answers to these further questions may be of some interest.

*Appendix: List of Interviews*

<b>Name</b>	<b>Date</b>	<b>Location</b>
Paul Austin	September 30, 2005	London
Bob Blower	December 6, 2005	London
Thomas A. Bond	November 9, 2000	Chicago
Michael J. Carusillo and Clayton Struve	November 7, 2000 and November 8, 2000	Chicago
Geoffrey Chamberlain	June 22, 2001	London
David T. DeArmey	November 8, 1999	Chicago
Joseph Doherty	December 4, 2000	London
John Ewan	September 30, 2005	London
Andrew Garrood and Paul Laight	October 20, 2004	London
John C. Hiatt	November 7, 2000	Chicago
Timothy F. Hinkes	November 8, 1999 and November 6, 2000.	Chicago
M. Blair Hull	November 10, 2000	Chicago
Sir Michael Jenkins	March 16, 2000	London
Thomas P. Knorring	November 10, 2000	Chicago
Barry Lind	November 9, 2000	Chicago
James J. McNulty	November 6, 2000	Chicago
Leo Melamed	November 8, 2000	Chicago
William R. Power	November 10, 2000	Chicago
Burton R. Rissman	November 9, 1999	Chicago

Daniel Sheridan	January 27, 2006	Petts Wood, Kent
David Steen	June 21, 2001	Sevenoaks, Kent
Paul G Stevens Jr.	November 8, 1999	Chicago
Joseph W. Sullivan	October 24, 2000	Knoxville TN
David Weinberger	November 9, 2000	Chicago
David Wenman_	June 22, 2001 and June 28, 2001	London and by telephone from Edinburgh
Stuart Wheeler	March 1, 2005	London

## *References*

- Abolafia, Mitchel Y. 1996. *Making Markets: Opportunism and Restraint on Wall Street*. Cambridge, MA: Harvard University Press.
- Allen, Franklin, and Douglas Gale. 1994. *Financial Innovation and Risk Sharing*. Cambridge, MA: MIT Press.
- Arnoldi, Jakob. 2004. "Derivatives: Virtual Values and Real Risks." *Theory, Culture & Society* 21/6:23-24.
- Arthur, W. Brian. 1984. "Competing Technologies and Economic Prediction." *Options* April:10-13.
- Barnes, Barry. 1983. "Social Life as Bootstrapped Induction." *Sociology* 17:524-545.
- Barnes, Barry, and David Edge (Eds.). 1982. *Science in Context: Readings in the Sociology of Science*. Milton Keynes: Open University Press.
- Beunza, Daniel, Iain Hardie, and Donald MacKenzie. forthcoming. "A Price is a Social Thing: Towards a Material Sociology of Arbitrage." *organization Studies*.
- Callon, Michel. 1998. *The Laws of the Markets*. Oxford: Blackwell.
- . forthcoming. "What does it mean to say that Economics is Performative?" in *Performing Economics*, edited by Donald MacKenzie, Fabian Muniesa, and Lucia Siu.
- Cronon, William. 1991. *Nature's Metropolis: Chicago and the Great West*. New York: Norton.
- David, Paul A. 1992. "Heroes, Herds and Hysteresis in Technological History: Thomas Edison and 'The Battle of the Systems' Reconsidered." *Industrial and Corporate Change* 1:129-180.
- Falloon, William D. 1998. *Market Maker: A Sesquicentennial Look at the Chicago Board of Trade*. Chicago: Chicago Board of Trade.

- Fleck, James. 1994. "Learning by Trying: The Implementation of Configurational Technology." *Research Policy* 23:637-652.
- Goede, Marieke de. 2005. *Virtue, Fortune, and Faith: A Genealogy of Finance*. Minneapolis: University of Minnesota Press.
- Hall, Peter A., and David Soskice (Eds.). 2001. *Varieties of Capitalism: The Institutional Foundations of Comparative Advantage*. New York: Oxford University Press.
- Knorr Cetina, Karin, and Alex Preda (Eds.). 2005. *The Sociology of Financial Markets*. Oxford: Oxford University Press.
- Kynaston, David. 1997. *LIFFE: A Market and its Makers*. Cambridge: Granta.
- Latour, Bruno. 1987. *Science in Action*. Cambridge, MA: Harvard University Press.
- Latour, Bruno, and Steve Woolgar. 1986. *Laboratory Life: The Construction of Scientific Facts*. Princeton, NJ: Princeton University Press.
- Lerner, Josh. 2002. "Where does *State Street* Lead? A First Look at Financial Patents, 1971 to 2000." *Journal of Finance* 57:901-930.
- Leslie, James, and Geoffrey Wyatt. 1992. "Futures and Options." Pp. 85-110 in *Markets and Dealers: The Economics of the London Financial Markets*, edited by David Cobham. Harlow, Essex: Longman.
- LiPuma, Edward, and Benjamin Lee. 2004. *Financial Derivatives and the Globalization of Risk*. Durham, NC: Duke University Press.
- . 2005. "Financial Derivatives and the Rise of Circulation." *Economy and Society* 34:404-427.
- MacKenzie, Donald. 1990. *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance*. Cambridge, MA: MIT Press.
- . 2004. "The Big, Bad Wolf and the Rational Market: Portfolio Insurance, the 1987 Crash and the Performativity of Economics." *Economy and Society* 33:303-334.

- . 2006. *An Engine, not a Camera: How Financial Models shape Markets*. Cambridge, MA: MIT Press.
- MacKenzie, Donald, and Yuval Millo. 2003. "Constructing a Market, Performing Theory: The Historical Sociology of a Financial Derivatives Exchange." *American Journal of Sociology* 109:107-145.
- Mason, William. 1999. "Rate Setting in London." British Bankers Association, typescript.
- Maurer, Bill. 2001. "Engineering an Islamic Future: Speculations on Islamic Financial Alternatives." *Anthropology Today* 17/1:8-11.
- . 2002. "Repressed Futures: Financial Derivatives' Theological Unconscious." *Economy and Society* 31:15-36.
- . 2005. *Mutual Life, Limited: Islamic Banking, Alternative Currencies, Lateral Reason*. Princeton, NJ: Princeton University Press.
- Melamed, Leo, and Bob Tamarkin. 1996. *Leo Melamed: Escape to the Futures*. New York: Wiley.
- Merges, Robert P. 2000. "One Hundred Years of Solicitude: Intellectual Property Law 1900-2000." *California Law Review* 88: 2187-2240.
- Miller, Daniel (Ed.). 2005. *Materiality*. Durham, NC: Duke University Press.
- Millo, Yuval, Fabian Muniesa, Nikiforos S. Panourgias, and Susan V. Scott. 2005. "Organized Detachment: Clearinghouse Mechanisms in Financial Markets." *Information and Organization* 15:229-246.
- O'Brien, Richard. 1992. *Global Financial Integration: The End of Geography*. London: Pinter.
- Patel, Kanak. 1994. "Lessons from the FOX Residential Property Futures and Mortgage Interest Rate Futures Market." *Housing Policy Debate* 5:343-360.
- Pryke, Michael, and John Allen. 2000. "Monetized Time-Space: Derivatives - Money's

- 'New Imaginary'?" *Economy and Society* 29:264-84.
- Sandor, Richard L., and Howard B. Sosin. 1983. "Inventive Activity in Futures Markets: A Case Study of the Development of the First Interest Rate Futures Market." Pp. 255-272 in *Futures Markets: Modeling, Managing and Monitoring Futures Trading*, edited by Manfred E. Streit. Oxford: Blackwell.
- Silber, William L. 1981. "Innovations, Competition, and New Contract Design in Futures Markets." *Journal of Futures Markets* 1:123-155.
- Sørensen, Knut H., and Robin Williams (Eds.). 2002. *Shaping Technology, Guiding Policy: Concepts, Spaces and Tools*. Cheltenham, Glos.: Elgar.
- Steen, David. 1982. "How Traded Options Started." *Money Observer* 27 April.
- Swan, Edward J. 2000. *Building the Global Market: A 4000 Year History of Derivatives*. London: Kluwer.
- Tamarkin, Bob. 1993. *The Merc: The Emergence of a Global Financial Powerhouse*. New York: HarperCollins.
- Thompson, Paul. 1997. "The Pyrrhic Victory of Gentlemanly Capitalism: The Financial Elite of the City of London, 1945-90." *Journal of Contemporary History* 32:283-304 and 427-440.
- Thrift, Nigel. 2000. "Pandora's Box? Cultural Geographies of Economics." Pp. 689-704 in *Oxford Handbook of Economic Geography*, edited by Gordon L. Clark, Meric S. Gertler, and Maryann P. Feldman. Oxford: Oxford University Press.
- Tickell, Adam. 1998. "Unstable Futures: Controlling and Creating Risks in International Money." *Socialist Register*:248-277.
- . 2000. "Dangerous Derivatives: Controlling and Creating Risks in International Money." *Geoforum* 31:87-00.
- Tufano, Peter. 1989. "Financial Innovation and First-Mover Advantages." *Journal of Financial Economics* 25:213-240.

—. 2003. "Financial Innovation." Pp. 307-335 in *Handbook of the Economics of Finance, vol. 1A: Corporate Finance*, edited by George M. Constantinides, Milton Harris, and René M. Stulz. Amsterdam: Elsevier.

Vintcent, Charles. 2002. *How to Win at Financial Spread Betting*. London: Pearson.

Zaloom, Caitlin. 2003. "Ambiguous Numbers: Trading Technologies and Interpretation in Financial Markets." *American Ethnologist* 30:258-272.

—. 2006. *Out of the Pits: Trading and Technology from Chicago to London*. Chicago: Chicago University Press.

