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Creating flows of interpersonal bits: the automation of the London Stock Exchange, *c.* 1955–90

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Abstract

This article deals with the concept of market information. In particular, it argues that references to the so-called conduit metaphor, which represents markets as a series of information flows, hide the localized, historically contingent and materially mediated practices of the economy. Following the tradition of the performative theory of social institutions, this article argues that the specific meaning of 'market information' and its concrete manifestations (e.g. prices) depend on the socio-technical character of the calculative practices through which market participants orient their economic actions. The point is illustrated through a historical reconstruction of the introduction of price and quote dissemination technologies in the London Stock Exchange between 1955 and 1990. By highlighting the historical and technological contingency of prices, the case of the London Stock Exchange shows that it is impossible to provide a universally and temporally invariant definition of market information.

Keywords: market information; performative theory of social institutions; London Stock Exchange; automation; digitalization.

Introduction

'Trading securities is pretty much 100 per cent information flow', said George Hayter in 2007 while sitting in his living room on a rainy November afternoon.

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'There isn't much else, really', he continued. 'Starting with market information to the broker and his client, generating an order, [and ending in the] contractual exchange of ownership and exchange for money. . . . The whole blazing thing is actually information flow, from start to finish' (Hayter interview).

Hayter's remarks, made twenty-one years after London's Big Bang, were the product of a privileged historical position. A bit of a polymath by education and training, George Hayter spoke on the basis of a broad personal experience in managing the systems that, as observers contend, facilitated (perhaps even structured) the flow of information within the financial marketplace of the City of London. Hayter, in particular, served as the director of the technical services department of the London Stock Exchange between 1976 and 1990, the critical period during which a 200-year-old tradition of face-to-face dealing ended with the rise and consolidation of trading screens, digital data-feeds, computers and telecommunications as the basis of modern finance.

Hayter is not alone in reducing the market to a series of information flows. Central to the imagery of contemporary economic thought stands a rendering of markets as machines engaged in capturing, processing and distributing 'information' (consider, for instance, the disciplinary history presented by Mirowski [2002]). Within this canonical representation, prices and other quantitative indices, long considered paradigmatic manifestations of economic life, acquire a fundamental role. They constitute none other than mechanisms of communication between the individual and the collective – a price system, in the classical sense – becoming entities 'in which all relevant information is concentrated' (Hayek, 1948). Indeed, in the realm of finance, partly built through the expertise and material contributions of Hayter and his peers, prices are peculiar mirrors for the world. They allow capital markets, as argued by one of the central tenets of modern financial economics, to 'always ''fully reflect'' all available information' (Fama, 1970).

To interpret prices as conveyers of information, or to understand the market as a series of interconnected information flows, is a mutation of what linguist Michael Reddy termed the 'conduit metaphor' (1979). For Reddy, in our language about language, speakers convert ideas into objects, put objects into words and send words along conduits to hearers who take the ideas/objects out of their words/containers (Lakoff & Johnson, 2003). The conduit metaphor resonates with a dominant economic representation of the market, portraying information as an object (with its associated objective ontology) which is incorporated into symbolic units (for instance, prices) which travel through a certain infrastructure (such as newspapers) to affect the state of a receiver (say, an investor). In effect, few are immune to the pervasiveness of this linguistic construct. The growing literature on the sociology of markets is an example, representing information in a manner that echoes the language of conduits and flows. Within this literature, information is an entity that is 'obtained', 'accessed', 'diffused' and 'provided' (Granovetter, 1983), 'leaked' (Swedberg, 2005), 'channelled' and 'possessed' (Guseva, 2007) and which can 'flow', 'arrive', be 'exchanged' and, *pace* economics, 'contained' not only in prices but

also in their movements (Knorr Cetina & Bruegger, 2002). When used in explaining the market, however, the conduit metaphor poses an analytical risk insofar as it may don the numbers, texts and images encoded in the digital electric pulses that percolate and structure contemporary finance as possessing inherent, one might dare say objective, qualities.

The centrality occupied by this information/conduit metaphor primarily in economic narratives, secondarily in the sociology of markets, calls for a well-known act of re-socialization. In bringing economic life back into the domain of social interaction, in showing that the market is as social and political as other institutions, 'information' has to make explicit its contingent, communitarian, embedded and materially mediated character, stripping it of what is normally adduced as an objective, independent ontology. And, just as the sociology of scientific knowledge showed that the photographs of the ionization tracks produced in a cloud chamber do not in and of themselves tell an observer anything about the physical world, a new sociology of markets should deconstruct the putative blood of the economy, that is, the bits and symbols communicated through television and computer screens across the world and that serve as triggers of economic action. This act of socialization is the task performed in the following pages.

In making information a social phenomenon, this article seeks to focus on two specific questions that are pertinent for the contemporary literature on the sociology of markets in general and, more specifically, for the sociology of finance. The first question, and the broadest in scope, relates to the meaning of information in the marketplace. It asks, in particular: what constitutes market information? The second, less general in nature, derives from the patently important historical trend of the automation and computerization of finance, visible in a replacement of modes of trading based on face-to-face verbal exchanges (and their associated interpersonal interactions and administrative institutions) with purportedly anonymous and depersonalized dealing mechanisms mediated by artefacts such as computerized order-books, spreadsheets and trading screens. This question can be formulated as follows: how is it that we come to say, both historically and sociologically, that the characters and texts on a screen constitute market information?

The answers to the above-formulated questions derive from a specific case in the history of modern finance, namely, the mechanization, automation and eventual digitalization of the London Stock Exchange between 1955 and 1990. During this period the Stock Exchange experienced a series of technological, regulatory, organizational and cultural transformations that hold great similarities to other stories found in the histories of finance elsewhere. The Stock Exchange changed venues; it expanded its reach by merging with provincial exchanges; it increased its staff many-fold; it changed its codes and structure of operation; and it went from being a club-like organization that contained and regulated the market, provided centralized settlement services, acted as a trade association and controlled the listing of new companies to being 'merely' the electronic hub for market transactions that it is today (Michie, 1999). Within

what can be considered the mythology of British finance, the climax of this transformation occurred on 27 October 1986, when a set of changes colloquially known as Big Bang were implemented in unison in the market. Among these was the introduction of a real-time electronic quote dissemination system named Stock Exchange Automated Quotations (SEAQ) that factored directly into the demise of face-to-face dealings in equities on the floor of the Exchange.

Methodologically, this article is built upon the review and interpretation of two types of empirical materials. The first corresponds to documents associated to the London Stock Exchange during the period between 1950 and 1990. These include such items as the *Code of dealing*, which epitomizes much of the social and verbal practices that supported finance on the floor of the Stock Exchange. The documents used in this study were obtained as part of several visits to the Guildhall Library and British Library, London. The second type of sources corresponds to a series of interviews conducted by the author between May and November 2007 with 'technologists', brokers and jobbers originally associated to the Stock Exchange when price and quote dissemination systems were introduced into the London stock market. The bulk of the interviews were with technologists involved in building market information systems which included price and quote dissemination systems. Interviews with brokers and market-makers were used to corroborate the accounts of the technologists. The provisos of oral history and qualitative sources apply. Use was also made of some oral histories of jobbing, compiled by Dr. Bernard Attard of the University of Leicester. Attard's interviews, however, are presented without revealing the identity of the interviewees.

A market of interpersonal prices

In many ways, the history of the London Stock Exchange can be deconstructed in terms of three co-evolving and interlinked trajectories. The first deals with the re-materialization of the market through the development and introduction of initially mechanized and eventually automated information systems. The second concerns the transformations of the Stock Exchange as a legal entity. And the third and final relates to the changing patterns of finance-as-practice and finance-as-culture experienced within the Stock Exchange and the City of London at large. Clearly, the definitional issue of market information is a thread linking these three trajectories. Yet, in this article, I will focus mainly on the first, that is, on the material changes that brought about the alleged reconfiguration of the Stock Exchange's marketplace around the notion of finance-as-information flows.

To say that finance is all about 'information flows, from start to finish', as George Hayter remarked in 2007, is a relatively recent metaphorical affordance. Indeed, such comment would have been untenable in the Stock Exchange during the two decades following the end of the Second World War. Although tranquillizing then, the end of hostilities in Continental Europe provided little

practical relief to the British equities market. Like much of the large financial institutions in the United Kingdom, the London Stock Exchange survived the war at great cost. The need to secure financial resources for the nation's wartime efforts required strict controls over the economy that translated into a redistribution of powers within the City of London. As the dust of the war settled, it became clear that the Stock Exchange would share political space with, and in some cases be subjected to, the Treasury and the Bank of England, two institutions that effectively came to oversee the securities market in Britain. The Stock Exchange withdrew to a conservative state. In this new world, the role of the organization was reduced from what it had been fifty years earlier, to enforcing market discipline between its members 'so creating a climate of trust ... conductive to business' (Michie, 1999). The prime metaphor of the market at the time said nothing of information: quite often, the Stock Exchange was represented in terms of a wholesale produce market, where sellers attracted the business of buyers by modifying the prices of their products (in this case, not apples or pears but shares and bonds) as they saw fit. And here, the technology that served as the veritable material support of the market was the floor of the Stock Exchange, the meeting point and centre of liquidity for those performing finance day in and day out.

The genesis of prices on the floor of the Stock Exchange (prices that in today's metaphorical terminology are receptacles of information) occurred within a particular institutional arrangement referred to as single-capacity. Under single-capacity, making a market involved the coordinated work of two types of professionals. The first, stockbrokers, served as intermediaries between investors and the market. They could not act as principals, only as agents of investors. Stockjobbers, on the other hand, dealt on their own account by buying and selling shares, profiting from the differentials between bids and offers, and were explicitly forbidden to deal directly with investors. This longstanding division of economic/epistemic labour (formalized as recently as 1909 but that existed informally since at least the early nineteenth-century) translated into a specific spatial arrangement of finance with its concomitant spatially sensitive practices.[1]

The trading floor, housed in a building erected in 1853 on the site of the first Stock Exchange, was both the locale and the embodiment of this spatial arrangement. Historically, the floor had grown in a fragmented manner, with particular areas devoted to trading in specific types of securities. Over short spans of time, the layout of the floor was relatively stable, determined by the jobbers who worked from fixed positions called pitches. To a certain extent, this geography of the trading floor emerged and was sustained merely as a matter of practicality: the proximity of jobbers that specialized in similar shares implied brokers had to walk less distance when searching for the best price in the market. Yet this spatial arrangement was not necessarily explicit. As some have suggested, an understanding of the market floor was learnt by ostention and everyday interaction. The recollections of Donald Cobbett, who joined the Stock Exchange in 1933, illustrate this point. Up to the 1950s the

pitches or stands of jobbers 'were ambiguously notional, and not . . . physically structural' (Cobbett, 1986). Similarly, lapel badges identifying members and dealers with their firms were not introduced until the 1960s. Indeed, the market was a maze in which jobbing firms

> assembled close around the walls and surrounding the massive pillars dividing the floor space irregularly into sections, had seating facilities, space to erect a price board, and improvised shelves for dealing books and other paraphernalia of the business. But a large number of jobbers not conveniently disposed, particularly the small firms such as the one I joined, were compelled to take their stand on the open floor, with the surging crowds of brokers and their clerks passing through and around them.
>
> (Cobbett, 1986, p. 22)

Forging interpersonal relations and keeping within the etiquette of face-to-face dealing on the floor was hence a matter of critical import. Being an outsider to the closed networks of the floor entailed a practical limit to what one could achieve, for instance, by not knowing how to identify the counterparty of a deal or the location of the jobbers best suited to transact in specific shares.

This division of labour on the floor of the Stock Exchange, along with the sheer spatiality of the marketplace, provided prices with some of their qualities. Prices, by the rules of the Stock Exchange as well as by the conventions of the floor, were produced by jobbers (effectively acting as market-makers) in the form of verbal utterances, making them limited in time and space by the physical possibilities of human voice and the prevailing auditory conditions of the marketplace. Equally important, jobbers created prices in the form of quotes (namely, bid/ask pairs) within the context of specific patterns of conversation. Within a 'normal dealing pattern', for instance, the quotes uttered by jobbers were produced at the request of a broker. The broker had to approach the jobber and vocalize something of the sort 'What are BP?' That is, in the conventions of the floor, the broker would ask the jobber whether he could provide a quote for shares in British Petroleum. To that, the jobber was obligated to reply with a quote, perhaps in the form of the utterance 'five hundred to five' ('500–5'), meaning that the price at which he was willing to buy 'a reasonable' (*Investors Chronicle*, 1961) number of shares was 500 pence (bid) while the price at which he was willing to sell was 505 pence (ask). To this reply, the broker could have followed one of several paths: he could have agreed to buy at a volume pre-indicated by the client (that is, to execute the deal) for which he would just had to have uttered something like 'Take 500' (sell) or 'Take 505' (buy); he could have mentioned that he was only quoting (that is, had been asked by the firm or the client to find out the price of a particular share); or he could just have walked away to another pitch in search for a better price. To take any of these paths, both the broker and the jobber required an understanding of the conventions that surrounded the way words and sentences *should* be uttered (the normativity of conversations on the floor). Specific socially sanctioned codes on how one should talk, built over years of institutional practice and

standardization, determined the existence or lack of commitment between the parties involved. The operation of the Stock Exchange was therefore quite close to the spirit of its motto: *Dictum meum pactum* (My word is my bond).

The importance of conversational conventions was such that they formed part of the regulatory literature of the Stock Exchange. The *Code of dealing* (Stock Exchange, 1976) is one such example, providing a particularly accurate insight into the performative role (Austin, 1975) of certain linguistic conventions in establishing commitment on the floor of the Stock Exchange prior to the introduction of any form of digital visualization technologies. In it, we can observe, for instance, that to avoid committing to a deal, a broker needed only to utter specific words in a particular way (all the quoted below adapted from Stock Exchange, 1976, pp. 13–15):

> 'What are XYZ?' Answer: '125–8'
> *Broker*: 'I am only quoting. What is the size of the market?
> *Jobber*: 'I will make that (i.e. 125–8) in 2000'

The power of words on the floor was clear. By saying 'I am only quoting', the broker insulated himself from dealing. Yet the conversation could have gone elsewhere:

> 'What are XYZ? Answer: '125–8'
> *Broker*: 'Is there any way in 250?' [or, can you make a closer price one way for 250 shares?]
> *Jobber*: 'I'll make you 126–8'

Here again, a different path was taken, creating an agreement to either buy or sell 250 shares. By accepting an exchange of ownership over shares and bonds and by generating a register of the movement of legal documents of different kinds, this sequence of utterances created, in effect, a market price for that particular transaction. In this realization of a deal, and by not stating that he was only quoting, the broker was bound to the trade. Yet this did not mean that more extended forms of communication could not take place. If the broker had an order to trade limited as to price and was not authorized to ask for the 'way', the conversation could be as follows:

> 'What are XYZ?' Answer: '125–8'
> Broker: 'I am limited I'm ½p out in 250'
> Jobber: 'I could deal one way' [i.e. he could make either 125½–8 or 125–7½]
> Broker (hoping for the one which will suit him): 'Very well, you may open me'
> Jobber: 'Give you ½p' [i.e. 125½]
> Broker: 'Sorry, I'm a buyer at 127½'

In this instance, the quote faded into nothingness along with the words that comprised it. And with the end of the quote, with the broker leaving the pitch of the jobber, the price was not brought into existence.

Such dependencies on the spatiality of voice and on a normativity of conversations on the floor reinforced the generation of quotes as an

interpersonally mediated activity: it occurred in the context of a face-to-face interaction and thus required careful calculations of the counterpart's social character. Quotes were not only 'bound to the circumstances and the situation, [to] how many shares you were long or short on the book, [to] how the rest of the firm [was] positioned' (Steen interview); they were also connected to a 'knowledge of people', hierarchies of trust and the social ecology of the market. All things being equal, quotes would not necessarily be the same for different people from different firms. Partial evidence of the tailored character of quotes is visible in the reference literature on finance in Britain. For instance, in his frequently cited manual to the Stock Exchange, Berman insisted on trust as a prerequisite for jobber/broker interactions when he mentioned that '[in] order to be able to deal well a broker must be known, trusted and liked by the jobbers and to acquire their trust he must play fair' (1963). If the metaphor were pushed to the extreme, prices produced by successful deals were, in a sense, incommensurable bits associated to interpersonal forms of knowledge.

Voice was not the only method for communicating prices within the floor of the Stock Exchange. Due to the calculative intensity of life in the marketplace (during busy times jobbers had to produce prices constantly while brokers had to procure them continuously either for dealing or for relaying them to their offices), non-vocal props were introduced. The distributed forms of cognition (Hutchins, 1995) associated to jobbing and broking grew to involve both particular types of vocalizations as well as a range of inscription devices. Up to the early 1950s, these devices consisted primarily of 'printed price display boards [located in jobber's pitches] which required regular (almost daily) replacement' (Cobbett, 1986). (Cobbett speculates that wartime rationing, along with increases in the cost of printing, led firms to replace this system by Perspex boards on which the security titles were 'permanently printed or separately enslotted'). On these boards, jobbers and their clerks entered overnight closing prices in black and used chinagraph pencils to record the subsequent movements of prices. Specialized clerks referred to as 'blue buttons' 'alter[ed] the price of [the displayed stocks], using blue if they were going up and red if they were going down' (Attard interviews).

Whiteboards and similar equipments were therefore a visual representation of past prices, but, because of their mode of use, they remained limited: they represented only the market created by *that* jobber in *that* share; they did not constitute a visualization of the market-as-a-whole. Because of their visual and accessible characteristics, however, whiteboards served as coordinative devices, exposing quotes that would have otherwise been invisible. This is illustrated clearly by the recollections of a jobber who worked with the firm Wedd Durlacher before Big Bang (Stuchfield interview). If someone approached the pitch and asked for a price in BP,

> obviously, you had to think what BP are now. And, you know, two minutes ago I was thinking they were 500 to 5. But actually, I can see someone on the pitch opposite in different companies, mining stocks or something like that, a

> different sector completely. They just put a little blue up on the board, and something else has happened, and actually, now I think they're 500 to 7.

It is therefore plausible that the visual cues of the whiteboards linked prices across competing jobbers, even across different market sectors. In effect, at the level of the jobber, these instruments were strategic appendages. Two examples demonstrate this point. The first concerns 'big' deals. Since jobbers worked with the spread between buy and sell prices, holding large inventories was risky under certain circumstances. Control over prices was consequently important. In order to 'unwind their positions', it would not be uncommon for jobbers to be a 'bit reluctant to change their board prices, it may be that they've done a deal and don't want to broadcast [it] to the world' (Attard interviews). Whiteboards were therefore tools that allowed controlling the rate, direction and characteristics of some types of market signals. A second example relates to the construction of prices. In order to conceal his transactions from other jobbers,

> [one] might change the price [on the board], but it needn't necessarily be correct. Say, for example, you sold some shares at a £1, a lot of shares; well, in order to be clever you would mark the shares down to 19s 9d or something like that, you see, so that the other jobbers would think you probably bought the shares. So this was all part of the skilful back and forth play in the art of jobbing.
>
> (Attard interviews)

Despite their role as strategic appendages, whiteboards were subordinated ultimately to the utterances of senior jobbers and the logic of interpersonal knowledge of the trading floor. This subordination was evident in cases where whiteboards unintentionally contradicted the will of those managing the book. As a jobber reminiscing about his days as a clerk mentioned, updating prices on the whiteboard required time

> because as you were doing that so you were keeping an ear open for what your partner was doing if he was dealing. [Y]ou wanted to know what was going on, because quite clearly if he was doing a big deal there was going to be a change in price or what have you. One of these [brokers] would come up and say to you, 'What's the price of Welcome Gold', and you know, you'd suddenly shoot out a slightly old price and your partner might have heard and told you, 'No, they're not that at all, the price has changed'.
>
> (Attard interviews)

Whiteboards did not command the market. The prices displayed on them were by no means a pact with brokers on the floor. *Dictum meum pactum* extended only to utterances, not to their representations. Whiteboards and similar means of price visualization did not occupy the same representational role as modern trading screens; they were not the same type of technologies; and the prices therein displayed were not informative, at least not in the sense of the conduit metaphor. Whiteboards were instruments carefully woven into, but ultimately controlled by, the verbally-centred social practices of the floor.

Off the floor of the Stock Exchange, prices acquired an altogether different character. Incorporated into print sources such as the *Stock Exchange's Daily Official List* (SEDOL) and the *Financial Times*, off-floor prices became stable non-verbal entities. Within the confines of the broker's office these were used, in conjunction with other quantities, as referents for valuations, for the construction of portfolios and, in general, for tasks related to research on the state and prospects of the different sectors of the market. In this configuration, prices were always open to review. If a broker needed the 'real' price for a particular security (either because the client requested it or because it was required for some calculation), he would probe the market by communicating with blue buttons on the floor of the Stock Exchange who would then obtain the relevant quotes from the jobbers in their pitches. The prices extracted from the *Daily Official List* were thus malleable, however old. But these prices served as, and indeed were considered, information for brokers carrying out specific tasks. For those on the floor, old prices were useless, but for those outside the market, they were information, even though they were neither the 'best' nor the 'most current' prices available.

The EPIC marketplace

Towards the late 1950s and early 1960s, the London Stock Exchange embraced a growing trend within the securities industry to mechanize back-office operations. Mechanization, which was initially constrained to the costly, error-prone and labour-intensive Settlement Department, formed part of a broader strategy of the Stock Exchange to expand the services it offered to its membership while reducing the costs associated to running the market. In effect, just as punched-card machines entered the Stock Exchange through settlement in the late 1949, so did digital computers in 1966, carrying promissory images of mechanization that populated the minds of many within the organization. Changing the way of doing finance became a matter of changing practices, of embracing automation and the distinct materialities that it implied.

> If only jobbers could be persuaded to report bargains into [a centralized machine] as they were carried out it would clear all stocks automatically and, not only that, it would give a running record of the dealing prices in every broker's office, reducing the staff required [by brokers] and order rooms and the [floor] itself . . . . We might even reduce the costs to such an extent that small orders became profitable and the ideal of the Cloth Cap Investor at last became a reality.
>
> (Bennett, 1959)

Indeed, mechanization initially, and automation subsequently, not only implied a more efficient marketplace serving Britain as the nation's prime investment re-allocation mechanism. For jobbers and brokers, it entailed a different modality of finance-as-culture. 'The bloodless technocrats', wrote Geraldine

Keen in 1966 upon the purchase of the Stock Exchange's first computer, 'have found their way into this bastion of civilization. The dustbins of Throgmorton Street will be loaded with quill pens and thousands of lines a minute will be clacking from the tasteful buff-coloured peripherals of an ICT 1903.'

The potential applications of computers in finance soon found their way out of settlement and into other areas of the marketplace. By the late 1960s, at a time when the Stock Exchange was overhauling its facilities (a process that included a complicated on-site construction of a purpose-built twenty-six-storey building), computers collided with price dissemination. Seeking to expand the repertoire of services offered to its members, the Stock Exchange embarked on the creation of a system capable of communicating prices from the floor of the Stock Exchange to the offices of member firms. The system, called Market Price Display Service (MPDS) and based on a recently acquired Ferranti Argus 400 computer that distributed analogue signals through a coaxial cable network, consisted of a display service for the 'current middle prices of approximately 650 stocks on . . . 16 main channels' ('House notes', 1969). Following the usage of the whiteboards on the floor, the system showed the closing price from the previous trading session and up to five changes in the mid-price for each stock. The blue and red chinagraph pencils from the floor, however, were not represented since MPDS was set up to work on slightly modified black and white television sets. Two further channels featured the prices of new issues, special stocks, currencies and commodities. And a remaining pair of channels was used to broadcast company and other relevant announcements.

From its introduction in 1970, MPDS quickly became an embraced technological mash-up. The television receivers displaying prices of the most active shares in the market expanded throughout the offices of firms in the City of London. Jobbers on the floor quickly developed 'pretty good' relationships with MPDS price collectors, to such an extent that 'they'd walk to them and almost as they were walking up they would quote them a price' (McLelland interview). By relieving the blue buttons from some of their work, MPDS left them 'free to gather more specialized information. The new system has not rendered the old one obsolete but it has enabled it to be put to better use' ('Stock Exchange information computerised', 1970). And, as Margaret Hughes reported in the *Stock Exchange Journal*, '[i]n little over a year the City's brokers [became] a group of push-button devotees' (1971).

The prices displayed in MPDS, however, were not the only ones available to the market. They coexisted with those provided by at least two other services, namely, Exchange Telegraph & Co. (Extel) and the *Financial Times*. Three different teams of price collectors ran between pitches, acquiring quotes from different jobbers, at different times, and submitting them to different systems with different standards. The prices presented on MPDS were thus not the only representation of the market: '[there were] three different teams and what you could easily get at the end of the day were three different versions of the price of a stock like Shell or ICI' (Newman interview). In an attempt to control the uses of

prices generated on its floor and hence curb the emergence of competing markets in London, the authorities of the Stock Exchange denied Extel direct access to the floor in 1975, consequently absorbing their price collectors (Newman interview). The *Financial Times* was also banned from the floor, as fresh prices became an increasingly coveted resource. The subsequent amalgamation of price collection implied that there was now only one official mid-price for each share in the market, the quality of which had to be assured by faster and more reliable methods of collection and dissemination. The Stock Exchange, so to say, had (not so) inadvertently walked into the business of data provision.

Pressures to provide reliable and comprehensive data on the equities market in London led the Stock Exchange to pursue a new system. In the world of so-called information vendors, prices had to be malleable; they had to be flexible and usable. The analogue character MPDS, however, allowed no modification to the contents or further processing of the prices. The prices fed both into and out of the Ferranti Argus 'were only used on that system. They could not be put to any other use' (McLelland interview). Facing increased competition from data providers such as Reuters and Datastream, and pursuing a policy that stressed control over the prices produced on its floor, the Stock Exchange established a venture with Extel to develop a system for distributing prices 'as a digital feed to everyone' (Scannell interview). The result was a replacement of the Ferranti Argus and the development of a central digital database housed within the so-called Exchange Price Information Computer, EPIC. Contrary to its computational predecessor, the Argus 400, EPIC 'held information about every stock traded on the floor (identified by its 4 character EPIC code) such as yesterday's closing price, today's opening price, the last few prices etc' (Buck, 2008). From EPIC's database, prices could be transmitted either to the screens of MPDS or directly to the computers of information vendors located across the world. By generating digital signals that could travel through conventional telephone lines, EPIC hinted at the materially mediated flexibility of the financial space of the future.

In the late 1970s, the technical limitations of MPDS led the Stock Exchange to pursue an aggressive technological strategy. For Patrick Mitford-Slade, then Chair of the Information and Communications Committee of the Stock Exchange: 'MPDS was marvellous, as far as it went. It only had twenty-two pages of information, and it was really just listing the shares on those twenty-two pages with an up to date market price on it' (Mitford-Slade interview). Indeed, for market participants, the system provided by MPDS was 'extremely crude', recalled Scott Dobbie, a former broker with Phillips & Drew (Dobbie interview). The real price 'was always on the floor', the place with which one had to communicate to execute an order or discover the best bids and offers for particular shares. Whatever the solution implemented, the system replacing MPDS needed to be both commercially viable, able to handle 'an unlimited amount of information' (Mitford-Slade interview) and, eventually, allow some form of dissemination of real-time prices.

The experience gained by the technologists of the Stock Exchange's technical services department with the development and maintenance of MPDS led them to seek an entirely digital alternative for price dissemination. In what became a serendipitous event, Peter Bennett (one of the Stock Exchange's leading technologists) identified Prestel, developed by the Post Office, as the standard that could serve as the foundation for the new system. In effect, Prestel allowed the creation of 'a two-way system, as opposed to broadcast video' (Bennett interview), allowing bidirectional communication between the terminal and the computer. Furthermore, by digitalizing the transmission of signals and optimizing the bandwidth, the number of pages could increase dramatically. The successor to MPDS, a robust system named Teletext Output of Price Information by Computer (TOPIC), thus emerged within the City of London.

After going live in 1978, TOPIC gained credibility rapidly, not least because the new system allowed member firms to visualize data through colour, text and graphics and distribute information through closed user groups (Newman interview). (In fact, the number of pages associated to closed user groups quickly surpassed the number of pages for prices.) Within two years of its introduction, the number of TOPIC terminals rose from the 400 initially authorized by the Council to several thousand. Indeed, as a service, TOPIC was much more comprehensive than MPDS: it encompassed thousands of pages divided into several 'magazines' (one for prices, one for traded options and one for news items) and, after some technical modifications, it allowed member firms to format, personalize and even appropriate the TOPIC screens by processing the Stock Exchange's Prestel-like feed. TOPIC, however, inherited some of the logic of the previous system: the prices it displayed were 'mid-prices for each company with a kind of trend indicator against them' (McLelland interview). And, because it relied on floor reporters, it continued to be an indicative system and not a representation of the quotes available on the floor of the Stock Exchange.

From mid-prices to containers of information

Although an important change to the *agencements* of the London stock market, TOPIC was far from being a representation of the market upon which either brokers or jobbers would engage in instrumental market-oriented action. The prices on TOPIC were not extensive to the market; they relied on the price collectors on the floor; and they were averages, or selections, over specific jobbers. The floor continued to be the origin of prices and the space in which dealing was performed. Screens were merely imperfect proxies for a possible state of the market.

Indeed, the degree to which the floor operated as a technological assemblage geared for informational purposes can be inferred from official statements issued by the Council of the Stock Exchange around the time during which

some of the above-mentioned price dissemination systems were introduced. In 1973, and reacting to claims made by a Working Group of the Labour Party Industrial Policy Sub-Committee, the Council presented the floor as the natural niche, or natural point of diffusion, of information. Opposing the Working Group's view that information often took 'several days' to reach investors hence allowing for insider trading and other undesirable practices, the Council wrote:

> The Stock Exchange [acknowledges] the reality that there is no way in which news can be received by all individuals simultaneously throughout the country. By requiring all company news to be published first at The Stock Exchange it insures that all Brokers have the information and are therefore able at least to prevent their clients acting in ignorance of it. Because the jobbers are also instantly apprised of the information and if necessary adjust the market price it is by definition impossible for any operator, however slick, to gain an advantage over any other once the news is published in the Market. Once an item of news has been announced the price in the Market at once reflects that news. If of course by whatever means the operator can anticipate the news this may be at the Jobber's expense and not at the small investor's.
>
> (The Council of The Stock Exchange, 1974)

The purpose of the floor was thus to create informational equality through the proximity of jobbers, who made markets, and brokers, who acted as agents of the investors. In effect, this view of the floor as an optimal information arrangement, mediated through interpersonal connections, continued to exist as late as the mid-1980s among the membership of the Stock Exchange.

But change, indeed, came in the early 1980s. A legal process that traced its origins to 1974 when the Stock Exchange was required to register its rules and regulations with the Office of Fair Trading, reached a decisive point in 1983. To avoid a costly (and quite likely unsuccessful) battle in court, the Stock Exchange reached an agreement with the Department of Trade and Industry. Eventually, the agreement named after Nicholas Goodison, Chairman of the Stock Exchange, and Cecil Parkinson, Secretary for Trade and Industry for Margaret Thatcher, committed the Stock Exchange to carrying out a series of reforms to its structure and mode of operation. The first implied the elimination of fixed commissions in broking, which had existed for decades. The second entailed a renovation of the membership, liberating the cap of ownership over member firms. And the third called for an end to the practice of single-capacity, opening the floodgates for mergers and acquisitions and ushering in a world of large, better-capitalized financial conglomerates. As per the agreement, the changes would be implemented no later than 31 December 1986. In due course, the decision was made to start anew in one stroke, implementing all changes in one Big Bang, on a date set for late October 1986.

The end of single-capacity proved to be a particularly important technical challenge. Although double-capacity existed for dealings in international shares, its introduction to the domestic equities market required redesigning

the market and its infrastructure. After a period of research and discussion of the available options, an American model was chosen as the partial template for London. NASDAQ, the automated quotation service of the National Association of Securities Dealers, became the source of inspiration for the Stock Exchange. 'NASDAQ was intriguing', remembered George Hayter, 'because [their] market-makers looked a bit like [our] jobbers, except that they were dual-capacity, they were able to trade on the one side with their clients and on the other side for themselves' (Hayter interview).

As the deadline of Big Bang loomed above the Stock Exchange's head, the development of systems followed a pragmatic approach. Plans for an integrated data network, conceived in 1980, that would have set a standard of communications for the entire British securities industry (that contemplated, indeed, full automation on a global scale by means of a globally accessible order book) were shelved. Instead, the technologists at the Stock Exchange focused on the construction of a technological Bailey bridge that would take the market through 1986. With hindsight, and paraphrasing Jean-Paul Sartre, the technological bet at the Exchange was placed years before Big Bang, with the selection and design of TOPIC and EPIC. In late 1984, as Peter Bennett, one of the chief technologists at the Stock Exchange, drew plans for a completely automated financial world, Hayter presented London's newest bridge. Initially code-named SEMANTIC (for Stock Exchange Market ANd Trade Information Computer) and later known as SEAQ (for Stock Exchange Automated Quotations), the solution implied a modification of TOPIC and EPIC that allowed bidirectional distribution of quotations from either the trading floor or the offices of member firms and their subsequent visualization in TOPIC. Trades under this system were conducted over the phone or face-to-face, and were then entered into SEAQ terminals. The system was 'not exactly rocket science', recalled Peter Buck, one of its developers. All SEAQ was, said Bennett in interview, 'was TOPIC, really. It was it was just TOPIC and EPIC brought together. [The system was] two legacy systems [put] together essentially, which was actually quite a safe route'.

Under the dual-capacity modality given by SEAQ, competing market-makers (formerly jobbers) were required to keep continuous quotes for the securities in which they traded. Rather than being uttered on the floor, these quotes were entered into SEAQ. Upon seeing a satisfactory quote on the screen, a broker would phone a jobber to carry out a deal (preserving the logic of *Dictum meum pactum*, market-makers could not modify their quotes once their phones rang). Such mode of operation entailed changing the nature and inter-operability of the previous systems. EPIC, for instance, acquired greater importance as it became a centralized real-time database of the quotes fed by market makers into the system through SEAQ. TOPIC, on the other hand, changed its visual layout to accommodate the needs of brokers: mid-prices were no longer useful since, under the new rulebook, real-time quotes from each of the market makers in every share had to be displayed. The release of

TOPIC prepared for Big Bang therefore included individualized pages for each security. Figure 1 illustrates the precise configuration of the new TOPIC screen.

The new system thus entailed a radical change to the significance of the visual representations of prices displayed on the novel interface. On the one hand, transforming EPIC into a real-time database meant that the quotes shown on the screen were no longer representations of some possible state of the market: they were, in a very clear and legitimate way, the quotes that composed the market. On the other hand, the amalgamation of quotes into individualized pages for each traded security implied that, from afar, observers could now effectively visualize the supply and demand for each element in the market. They no longer needed to go from pitch to pitch, collecting different quotes at different times. All the quotes for all the securities were shown together, instantaneously.

The version of TOPIC released for Big Bang can therefore be understood as a scoping system (Knorr Cetina & Preda, 2007) of the London equities market. However, in and of itself, the meaning attributed to the quotes on TOPIC (that is, that they were the only quotes available) did not make physical presence on the floor of the Stock Exchange entirely redundant (in other words, did not make it an irrelevant informational device). In a market with upward of 3000

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SEAQ EXAMPLE                                                    PAGE
7210
INT COMP LTD          ICL   A     S  1000                     CLOSE 81
CHG +3    VOL  156    LT  82  3  9X  2  3  4                      11:22
          AKD    LMB    CTY    83  5    WED    SMI    GRN
AKD       83-7   1X2    GRV    81-6      2X1    SMI    82-5   2X1
BUC       82-6   2XL    HGV    82-7      3X2    SKG    82-7   1X2
CTY       83-6   3XL    LMB    83-7      1X3    WED    81-5   3X1
GRN       82-5   1X1    P&D    82-7      1X1

GEC    GLXO    BP     BTOL    RCAL    SHEL    TSCO    MEPC
212    965     491    243     244     643     191     *318#
```

Figure 1 A typical SEAQ/TOPIC screen

Notes: This page (taken from (Hamilton, 1986) shows the different bids and offers for share 7210 of International Company Ltd (abbreviated as ICL). On the second line, the letter 'A' next to ICL denotes that an announcement has been made; 'S 1000' indicates the number of shares that comprise a lot; and 'CLOSE 81' is the price at the close of business on the previous trading day. The third line functions as a ticker: 'CHG + 3' stands for the change in the mid-price since the previous night's close; 'VOL 156' represents the volume of lots traded so far; LT stands for 'Last Trades', and displays the prices of those trades: 82, 83, 89X (amount in excess of 25,000 share), 82, 83 and 84. The fourth line shows the distribution of quotes among traders and thus the so-called 'touch' (the best bid and cheapest offer): 83, bid by CTY and 85, offered by WED. Lines 5 to 8 represent the specific quotes of the 11 market-makers in ICL. The numbers '83–7' represent bid–offer pairs (that is, bid at 83, offer at 87). The quantities '1X2' represent the sizes of those quotes: bid for 1000 and offer for 2000). In cases where a market is made in more than 9000 shares, the letter L is used, as in '2XL'. The final two lines were proposed as a NYSE-style ticker in other shares.

securities (Chapman, 1988), some higher representation of the system-as-a-whole was necessary; the system required a 'surprise trigger' to allow 'events of interest to swim into view' (Knorr Cetina, 1999). Previously, such representation came via a series of interpersonal and highly embodied experiences. Knowledge of which brokers/jobbers were in the (physical) market and of the relation between the sounds of the floor and the 'activity' of the market was a crucial instrument in determining the general state of the system. It is hence not surprising to discover commitment by some firms to preserving the floor as an informational mechanism thought to provide a mode of dealing incommensurable, and superior, to the screen. In effect, under pressure from jobbers during the immediate lead-up to Big Bang, the Stock Exchange invested heavily on the floor (£2 million pounds, according to Mitford-Slade, who recalled that the floor had to be redesigned with 'screens facing two ways so that everyone was being kept informed'). By September 1986, twenty-eight market-makers had signed up for a pitch, with Smith New Court 'making particularly trenchant noises about keeping at least four dozen dealers on the floor' (Kynaston, 2002). Within days of Big Bang, however, 'some [market-makers] had gone, and within three or four months even [those who pushed for it] had gone because they'd realized that business wasn't on the floor ... And it moved very fast off the floor' (Mitford-Slade interview). In March 1987, only traded options remained on floor of the Stock Exchange, with dealings in equities and gilt-edged securities conducted entirely over the telephone and through SEAQ. 'In terms of physical markets', said Luke Glass, spokesperson of the Stock Exchange to *The New York Times*, 'it's the end of an era in London' ('London to end trading floor', 1987).

The rapid demise of the floor can be explained by three interrelated innovations introduced around the time of Big Bang that altogether modified the relationships between dealers, screens and quotes. The first was perhaps self-evident. Given the large number of shares in the market, the technical team of the Stock Exchange devised an indexing system for the pages on TOPIC (McLelland interview). This system, however, did not provide a precise representation of the state of each of these securities. It was merely a device for finding shares in the TOPIC universe.

The second innovation was developed in 1984 as part of the Stock Exchange's build-up towards Big Bang. Conceived by Michael Newman and Daniel Sheridan, this product eventually grew to be tantamount to British finance and was named ultimately the Financial Times Stock Exchange 100 share index, FTSE 100. Because of its composition and structure, FTSE 100 was an important departure from previous indexes. Not only was it better correlated with the 500 most active shares in the market but, contrary to the previous FT30, it was updated every minute, providing a snapshot of where the market was going as a whole (Sheridan and Newman interviews).

The third innovation was more enigmatic and successful. While the index merely provided the location of the pages within TOPIC, FTSE 100 gave only an aggregate snapshot of the most active shares reduced to a single number the

value of which varied through time. Introduced around the time of Big Bang and developed by Newman, the third innovation consisted of the addition into TOPIC of a so-called 'trigger page'. As Newman explained:

> I conceived of trying to put a proxy view of the market on a screen. So how do we do this? I came up with the idea that if we got the top 100 stocks and jammed them on to one page, then that would be a proxy. If you're not on the floor, and you can see what's going on in the main stocks, that page would be a proxy for you. Now how do you do that? A static view would not tell you the dynamics of the floor behaviour. So it's no good just seeing the prices. So what we came up with was a scheme we inherited from Teletext in which you could pulse signal, so that if a stock price had gone down, the price was shown on a red background, and it stayed like that for ten seconds and then went back to 'steady'. So as it changed, it lit up in red or blue, a bit like red and blue lights going on. And it stayed like this, so that if you kept seeing flashes, red or blue, you knew that the thing was damn active, and the more you saw changing, the more active it was. So if you saw the whole wretched hundred in changing colour you knew that there was mayhem, absolutely chaos. The other thing you could see by eye was that if you saw nearly everything red, you knew the floor was bombing out. If you saw everything blue, you knew it was all going up. But mostly you would see, say, three quarters blue and a quarter red, or something like that, so you got this feeling of what it was like. I designed [this page and] called it the trigger page, because the idea was that it would trigger you to go and look [the shares] up in EPIC[/TOPIC]. The trigger page ... became the most popular we'd ever had.
>
> (Newman interview)

The trigger page was the keystone of a self-referring representational system that made the floor redundant as an informational device. Nowhere is this clearer than in a conversation recalled by Newman:

> I was told this by one of the dealers I knew quite well when I visited him on the floor in the first or second day post-Big Bang. He said 'Christ all mighty! By the time I wander round the floor and find out the prices, they all know it in the office. They are ahead of me!' When he said to me 'they are ahead of me in the office', in living memory, this had never happened before. I knew that the days were up for the floor.
>
> (Newman interview)

Indeed, the triad formed by TOPIC, EPIC and SEAQ, supported by the regulatory and institutional changes to the securities industry in Britain, 'reduced' the market to screens and phones. But in a more fundamental way, this new *agencement* (Callon, 1998; MacKenzie, Muniesa, & Siu, 2007) transformed the prices on TOPIC into sources of information. Signs and symbols that had once been irrelevant for dealing, that had been mere indicators of the possible state of shares, were made informative: the mid-prices on the trigger page became sources of action (they 'triggered' a

response); the numbers that constituted FTSE 100 represented, in a standard manner, the market and its history; and the quotes on the individual pages revealed the supply and demand for each traded share. Interconnected by technological means, the prices on the different types of screens along with the graphical schemes that framed them thus occupied the place of the verbal utterances that once dominated the floor of the Stock Exchange. And, in taking their place, they became information.

Despite this transformation, the prices displayed on TOPIC were not dislocated from pre-existing personal relations. To a considerable extent, they remained interpersonal bits, notwithstanding the partial anonymization provided by the screen. From an institutional perspective, the City of London was redefined by Big Bang. Specifically, the old jobbing and broking firms had merged with foreign and domestic merchant banks, resulting in a market populated by a small number of large corporations and medium-sized new firms produced operating under double-capacity. As shown in Figure 1, only the initials of these new firms appeared next to the quotes on TOPIC. The identities of individual market-makers were fused with those of their parent institution. Hence, the system gave the appearance of anonymity.

Nevertheless, pre-existing social relationships between and within firms, the interpersonal bits of knowledge partially built upon experiential participation of the market on the floor, remained in the electronic universe. As a former jobber recalled:

> once SEAQ was introduced, we knew immediately what the best price was because it was up there on the screen. And we may not make. But there were an awful lot of retail brokers that would rather deal with Wedd Durlacher or BZW as it was now called, or Smith Brothers, or one or two other firms, rather than all these brand new twenty-five market-making firms they had no relationship with whatsoever, and didn't even know how to get a hold of them.

Dealers would not necessarily take the first offer. As was common on the floor, the possibility to 'unwind the position' through the networked relations of the community of brokers and market-makers went into the calculation of whom to deal with. The importance of this interpersonal component was such that it achieved a materialized form in the automated dealing of shares: the small order execution system introduced by the Stock Exchange (SAEF, for Stock Exchange Automated Execution Facility, rolled out in 1988–9), allowed users to provide a list of their preferred dealers, prioritizing particular firms subject to a best execution policy. In the words of one of the system's developers, Ian McLelland, 'we had to put in the option that you could decide, well, if [XYZ] are making that price I want to trade with them, because they're my preferred broker or trader' (McLelland interview). The comment of a former market-maker on the operation of SAEF corroborates McLelland's recollections: 'brokers . . . didn't actually want to deal with whoever was the best bid or the cheapest offer, because it was one of these twenty-five newcomers who

were there one minute and gone the next and they didn't really have a relationship with them.' The evaluation and interpretation of the *meaning* of prices hence required knowledge of who had 'uttered' them onto the screen. In the post-Big Bang environment, those who uttered were no longer identifiable faces on the floor; they were large corporate conglomerates and their entangled social/post-social relations. Prices on screens were informative, only insofar as they reflected both their perceived accuracy and the trust associated to their provenance. Interpersonal relationships continued to shape prices, even when these had allegedly become information on a screen.

Discussion and conclusions

The above story presents several lessons pertaining to the nature and role of market information in the operation of finance, some of which are applicable to other areas of economic life. The first is quite simple and, precisely due to its simplicity, is often ignored by the literature (particularly economic literature, where the objective ontology of information seems to be a norm). Dividing the technological history of the London Stock Exchange into three broad periods given by the characteristics of the price visualization technologies available to market participants (roughly corresponding to the years 1955–70, 1970–86, and 1986–90) one can observe that the meaning of information as an actor's category suffered several transformations.

In the first period (1955–70), during which the only price and quote visualization technology within the Stock Exchange were printed documents and the whiteboards located on the floor, the category of 'market information' was intrinsically associated with the interpersonally mediated practices that constituted finance in the City of London. Dealing was then a verbal activity, making conversational exchanges the foremost type of 'information' on the floor. Effectively, the division of epistemic and economic labour that defined the operation of the floor of the Stock Exchange and characterized the making of markets as a verbal activity dictated the definition of which material and verbal entities were to be deemed informative. Thus, information existed in numerous forms, some codified (such as company announcements located on noticeboards on the floor, prices in the *Stock Exchange Daily Official List* or the whiteboards on the pitches of jobbers) and others of a more embodied or interpersonal nature (from conversations held over lunch, meetings with company directors and telephone calls to distant centres of finance to the general level of sound on the floor as a measure of market activity). Common to all these entities was the fact that they *acquired* the designation of information, specifically in certain well-contextualized situations. In a sense, they were deemed as being information only if they formed part of the calculative practices and frames utilized by market participants (Callon & Muniesa, 2005). Hence, for a jobber specializing in mining shares, the announcement of a company in a sector such as retail stores did not constitute

information in the same sense as his firm's book or the prices displayed by a competing jobber in a similar industrial sector. Indeed, this pragmatic element of the meaning of information was revealed by the technological re-configurations of the Stock Exchange that followed the arrival of electronic visual means of price communication.

During the period given by MPDS and the first version of TOPIC (1970–86), prices were in effect widely distributed, overflowing the trading floor. Notionally, this seems to be quite similar to the configuration of existing electronic markets. Yet in practice, the prices on the screens of MPDS initially, and subsequently TOPIC before Big Bang, remained subordinated to the floor which was the place where the 'real' prices of shares resided. The verbal practices continued to define what constituted information. In the context of such practices and conventions, the prices on MPDS were not the basis upon which individuals would orient economic action in the market itself (i.e. the floor). The prices on these screens, however, did facilitate the emergence of new investment practices, allowing for participants to develop novel modes of economic action that had direct and indirect bearings upon the marketplace. For instance, they provided investors with a perception of the state of the market different from the one gained by the *Stock Exchange Official Daily List* or the lists of prices in the *Financial Times* and gave brokers the capacity to expand and refine their valuation and portfolio management services by reducing the work involved in collecting up-to-date prices from the floor. The re-categorization of on-screen prices as information in a modern sense (that is, as elements that lead to action and to a change of state in the market) came not as the result of a fundamental transformation of their character but as the effect of a re-structuring of the division of economic and epistemic labour in the marketplace. The end of single-capacity, coupled with the introduction of an automated real-time quote dissemination system, allowed market participants to utilize the prices on the TOPIC/SEAQ screens as the basis of action, becoming elements of the instrumental purpose-rational techniques of financial exchange.

Herein, another lesson from the technological history of the Stock Exchange emerges. The common strand linking the different manifestations of market information between these three periods is the fact that, in all of them, the use of the category of information resided on the capacity of a particular entity (a text, a conversation, a graph) to make a person *informed*. In effect, information seems to have been defined not in terms of some inherent quality of entities (say, their representational verisimilitude with some putative underlying economic reality) but rather in terms of the state associated to individuals who used such entities in their economic practices. This designation of 'being informed' is given not merely in terms of a capacity to hold sequences, numbers and other inputs in some proxy of a memory. Despite the impressive amounts of data that the hard drive of my computer may contain, it will never be 'informed'. 'Being informed' is, linguistically and metaphorically, a state that only people (and, in some uses, institutions) can achieve. As such, it is

similar to knowledge insofar as it is a collectively attributed status (Kusch, 2002), designated on the basis of some communally agreed standard. In all cases, there is nothing intrinsic in informed individuals, nothing in their physical constitution, which makes them unequivocally 'informed'. In being determined by collectives, the status of 'being informed' therefore responds to normative judgements: an analyst can be 'right' or 'wrong', he or she can be 'rewarded' or 'punished', according to how particular 'facts' are obtained, presented and mobilized. And through these forms of sanctioning, the identification of the state of 'being informed' is inherently self-referential: a person is said to 'be informed' mainly by comparison to other individuals who were previously labelled as being informed, as knowing the putative facts. New applications of the term are based upon previous instances, bootstrapping the category through successive uses (Barnes, 1983). The manner in which market participants are said to be informed therefore depends on localized histories and conventionalities of practice, sanctioning and cognition.

From here, we can go to a final lesson. In virtue of its constitution and definition through practice, the meaning and form of information within the market hinges on the configuration of the sociotechnical (and, incidentally, highly material) arrangements in which such practice occurs. As Daniel Beunza and David Stark (2004) so lucidly show, practices of calculation in finance (arguably, in the economy at large) are distributed through numerous human and non-human elements, implying a criticality of space, materials and social institutions. At a general level, market information is intrinsically associated to the materiality of calculative *agencements*. The history of finance in London illustrates this point through the conceptualization of the marketplace as an information machine. Recall, for instance, the creation of prices on the floor of the Stock Exchange in the mid-1950s. Before the introduction of electronic price dissemination systems, prices existed primarily as quotes made between a jobber and a broker, each reflecting the calculations made by the former on the intentions of the latter. In this environment, 'market information' was defined and configured by the interpersonal and spatially dependent characteristics of face-to-face dealing on the floor. Indeed, the comments made by the Council of the Stock Exchange on the report by a Labour Working Party in 1973 reflect the association between the meaning of 'market information' and the material affordances of the marketplace. In the view of the Stock Exchange, it was not the investor who had to be informed, but rather his or her broker. Hence, 'market information', in the form of company announcements or price movements, existed primarily on the floor, enabling brokers to deal on behalf of their clients. But this definition could be true only in a system in which face-to-face dealing was the norm, where single-capacity provided brokers with a particular identity (e.g. as *informed* agents to a larger community of investors), and where dealing occurred in the context of a particular spatial and material configuration (i.e. the floor, dominated by short-lived quotes uttered in the vicinities of jobbers' pitches). In a similar manner,

the success of SEAQ came not from the intrinsic communicational qualities of the screens released for Big Bang but rather from the accumulation of smaller innovations that allowed market participants to develop new practices of interaction with the contents of the screen (e.g. the trigger page and FTSE100). When these practices consolidated, the meaning of market information changed, and the prices on the screen ceased to be suspect entities, becoming integral elements of action; it was only then that the trading floor was abandoned; it was only then that screen prices were said to be informative.

Perhaps expectedly, the history of modern finance advocated in this article is not one of increases in the efficiency of information distribution within and between marketplaces. Admittedly, the digitalization of *haute finance* may have aided the expansion of established calculative practices (e.g. arbitrage; see Beunza, MacKenzie & Hardie, 2007) and allowed others to emerge (e.g. techniques of risk and portfolio management or day-trading). In this sense, digitalization may have fostered the consolidation of several facts that travel well through modern electronic data communication networks. The market in its full sense, however, is more than these facts and the calculative practices that produce them. Indeed, the market consists in and is reproduced by numerous practices that occur within localized communicational exchanges that are difficult to transport. Effectively, for financial markets, the conduit metaphor might be no more than a technologically-fuelled mirage. For example, as an element critical to the operation of the market and the stabilization of market relations, trust provides a form of contextualization. When evaluated in the context of relations of trust (whether in technology or individuals and organizations), the provenance of market data is a critical factor in determining its perceived usefulness, subsequently allowing an entity to be defined or not as information. Thus, the prices on SEAQ were not deemed informative until the reliability of the system became stabilized among market participants *vis-à-vis* other possible market configurations such as the floor. This entailed building trust between the firms, the Stock Exchange, the technologists and regulators in such a manner that SEAQ became a 'trustworthy' provider of prices that, through use, became informative. Trust, however, did not overflow SEAQ, and beyond it, prices were not obviously informative. Information, to an extent, is but a contingent outcome of practices, a measure of utility given locally to entities in orientating and coordinating economic action.

To conclude, the arguments presented above can be summarized as follows. There exists a widely accepted view of economic life as a process reliant on information. This view, replicated in the discourse of economics as in that of other disciplines, is supported by a metaphorical construct interpreting information as an entity that is, for all practical purposes, ontologically independent. This construct, identified as the conduit metaphor, entails that information travels contained in entities between emitters and receivers during communication. By bestowing an independent character on information, the

application of the conduit metaphor to the marketplace thus reduces economic interaction to a mechanical process that can be made increasingly efficient through 'better' means of communication. Referring to the history of price and quote dissemination technologies in the London Stock Exchange between 1955 and 1990, the concept of information in the market is re-examined. Market information, in particular, is rendered as a status attributed to communicational entities under circumstances dictated by specific and locally contingent economic practices. There is no single form of information or a single 'correct' use of information in the marketplace. Similarly, there is no single trivial way in which entities such as prices can be said to 'contain' information. Consequently, rather than being observations on the effects of the rise of the 'information society' on finance, statements that invoke the market as reducible to information flows serve as entry points for the analysis of the behaviours and unspoken assumptions of our economic fact-building practices.

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Note

1 The role of space in the economy, and of the configuration of the metrics of space through technology, has been a matter of academic interest for over a decade, arguably since the mid-1990s. Of particular relevance is the work of Saskia Sassen (e.g. 2000) and Nigel Thrift (e.g. 1996). This article, however, does not delve into the production of space in finance in order to keep the story as short and concise as possible.

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