Peripheral Vision: Economic Markets as Calculative Collective Devices

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Peripheral Vision

Economic Markets as Calculative Collective Devices

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How to address empirically the calculative character of markets without dissolving it? In our paper, we propose a theoretical framework that helps to deal with markets without suspending their calculative properties. In the first section, we construct a broad definition of calculation, grounded on the anthropology of science and techniques. In the next sections, we apply this definition to three constitutive elements of markets: economic goods, economic agents and economic exchanges. First, we examine the question of the calculability of goods: in order to be calculated, goods must be calculable. In the following section, we introduce the notion of calculative distributed agencies to understand how these calculable goods are actually calculated. Thirdly, we consider the rules and material devices that organize the encounter between (and aggregation of) individual supplies and demands, i.e. the specific organizations that allow for a calculated exchange and a market output. Those three elements define concrete markets as collective organized devices that calculate compromises on the values of goods. In each, we encounter different versions of our broad definition of calculation, which we illustrate with examples, mainly taken from the fields of financial markets and mass retail.

Keywords: calculation, markets, economic sociology, distributed cognition, actor-network theory

Markets are collective devices that allow compromises to be reached, not only on the nature of the goods to produce and distribute but also on the value to be given to them. The result is remarkable, considering that original situations are often ambiguous, frequently involving a large number of agents with conflicting ideas and interests, and that the quality and characteristics of goods are often extremely uncertain (Stark 1999; Thévenot 2001). The effectiveness of markets stems from the fact that they make complicated calculations possible, and that these produce practical solutions to problems that could not otherwise be solved by purely theoretical reflection.

If markets calculate, it should be possible to identify the entity or entities effectively responsible for calculation, in order to answer the simple question: who (or what) actually calculates (and how) when we say that 'the market' calculates? Answers waver between two extreme positions. The first corresponds to the solution opted for by neoclassical economic theory: agents calculate because they are calculative by nature. The second, preferred by

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sociology and anthropology, attempts to show that in observable behaviours calculation — considered to be a set of quantitative practices — is marginal and at best an ex post rationalization for choices grounded in other logics. Neither answer is particularly satisfactory. The former fails to do justice to the diversity of practices observed and the forms of calculation applied in markets. The latter denies any particularities in economic behaviours (Cochoy 2002). We believe that these difficulties stem from the absence of a precise definition of the notion of calculation.

In this article, we consider calculation in a way that seeks to expose the elements allowing markets to behave as calculative collective devices. In the first section, we propose a definition of calculation that oversteps the opposition between quantitative and qualitative aspects. We then compare this definition with three conventional categories of market activity: economic goods, economic agents and economic exchanges. In the second section, we examine the calculability of goods: to be calculated, economic goods have to be calculable. The third section analyses the distributed nature of calculating agents, to understand how these calculable goods are actually calculated. Finally, we consider the rules and material devices that organize the encounter between calculative agencies and calculable goods, i.e. the specific organizations that make a calculated exchange possible. These three elements — calculable goods, calculative agencies and calculated exchanges — define concrete markets as organized collective devices that calculate compromises on the values of goods. In each of them, we encounter different versions of our definition of calculation, which we illustrate with some empirical examples from financial markets and mass retail.

The Notion of Calculation Re-examined

Two risks should be avoided in the definition of market calculation. The first is the risk of reverting to an abstract and formal view of economic markets governed by impersonal laws (such as the law of demand) and consisting of disembodied economic agents reduced to their preferences and calculative competencies. The second risk, more subtle and more common in sociology, consists in simply getting rid of this cumbersome notion by dissolving the problem of calculation in the detail of ethnographic description. For many anthropologists, what was supposed to be a calculative behaviour proves to be a matter of pure judgement or conjecture or, when it can be observed, something originating in institutions or cultural norms. Whereas economics maintains the idea of a reality of 'pure' calculation, the other social sciences try, by contrast, to show that real practices are infinitely more complex and leave little room for calculative practices per se. Whether they are studying supermarkets (e.g. Miller 1998) or trading rooms (e.g. Knorr-Cetina and Bruegger 2002), ethnographers and sociologists tend to present actors who only rarely devote themselves to arithmetic operations in the strict sense, but interpret information and take decisions on the basis of heterogeneous, not necessarily well-defined criteria. In the final analysis, nobody calculates — which is the logical outcome of considering calculation in its limited sense.

Our point of view in this article is different. Calculating does not necessarily mean performing mathematical or even numerical operations (Lave 1988). Calculation starts by establishing distinctions between things or states of the world, and by imagining and estimating courses of action associated with those things or with those states as well as their consequences. By starting with this type of definition (wide, but usual) of the notion of calculation, we try to avoid the distinction (also conventional, but too sharp) between judgement and calculation.

The validity of this position, which usefully blurs the boundary between pure judgement and pure calculation, is confirmed by etymology. In his analysis of the vocabulary of accounting and estimation in Latin sources, Émile Benveniste (1973) notes that there is a close link between computing and assessing or estimating. He also points out a remarkable characteristic of this vocabulary: the explicit reference to a material movement of detachment (cutting) and reattachment (moving towards a result). The emphasis on material movement — also found in the 'centre of calculation' notion developed by Bruno Latour (1987) — helps us to formulate a very general definition of calculation as a three-step process:

First, in order to be calculated, the entities taken into account have to be detached. A finite number of entities are moved, arranged and ordered in a single space (see also Latour 1987; Bowker and Star 1999). This single space has to be conceived of in a very broad sense: it is the 'account' itself but also, by extension, the surface on which the entities to calculate are moved (literally or by delegation), then compared and manipulated on the basis of a common operating principle. It is important to take the variety of such calculative spaces into consideration. An invoice, a grid, a factory, a trading screen, a trading room, a spreadsheet, a clearing-house, a computer memory, a shopping cart — all these spaces can be analysed as calculative spaces, but all will provide different forms of calculation.

Once they have thus been sorted out, the entities considered (taken 'into account') are associated with one another and subjected to manipulations and transformations, still in a very material sense, as in the case of a mechanical calculator. An economy of calculation is precisely an economy of movements, as shown by Charles Babbage in his well-known description of the bankers' clearing-house in the City of London (Campbell-Kelly and Aspray 1996: 15–20). But these movements are also at work in less mechanical situations. A financial merger arbitrageur, for instance, materially associates two entities (a company and its target) by displaying their evolution on the same computer screen (Beunza and Stark 2004).

A third step is necessary to obtain an accomplished calculation: a result has to be extracted. A new entity must be produced (a sum, an ordered list, an evaluation, a binary choice, etc.) that corresponds precisely to the manipulations effected in the calculative space and, consequently, links (*summa*-rizes) the entities taken into account. This resulting entity is not new, in the sense of springing from nowhere; it is prefigured by the considerations described above. But it has to be able to leave the calculative space and circulate elsewhere in an acceptable way (without taking with it the whole calculative apparatus).

One of the main advantages of this definition is that, by emphasizing the crucial role of material devices, it inevitably points towards the diversity of possible configurations. It also points out a political dimension of calculability. Similar definitions of calculation allow Peter Miller and Michael Power to study the relations between calculability and government, with regard to accounting and managerial practices in particular (Miller 1994, 2001; Power 2004). Isolating objects from their context, grouping them in the same frame, establishing original relations between them, classifying them and summing them up are all costly activities that raise the question of calculative power.

This definition also enables us to analyse those calculative phenomena that are not 'pure'. A flaw in a calculation may be connected to a shortcoming in one (or more) of the three steps of the calculation process (the list of entities to take into account might be too long; an accurate calculation might require unavailable resources or an extended timeframe). Depending on the concrete achievement of each calculative step, calculation can either meet the requirements of algorithmic formulation or be closer to intuition or judgement. Such a definition establishes a continuum between qualitative judgement and quantitative (or numeric) calculation. It applies, in particular, to what Franck Cochoy calls 'qualculation', i.e. intermediate situations in which the customer has to choose certain objects placed beforehand in the same spatial and temporal frame (Cochoy 2002). It also enables us to understand how situations of non-calculation can be constructed, for instance by preventing the closure of the list of entities to be taken into account, by facilitating the proliferation of relations between those entities or by paralysing any attempt at classification (Callon and Law forthcoming). With this broad definition of calculation, the most appropriate dividing line is no longer between judgement and calculation, but between arrangements that allow calculation (either quantitative or qualitative) and those that make it impossible.

Making Goods Calculable

In a market transaction a good changes hands. Once the transaction has been concluded, buyers and sellers are quits. The good is detached from the seller's world and attached to that of the buyer. That is why the market transaction has sometimes been qualified as an alienation of goods: once concluded, the transaction helps to transform partners into virtual aliens (Callon 1998; Thomas 1991; Slater 2002). But this image can be somewhat misleading. Being quits and being aliens is not exactly the same thing. The protagonists in the transaction may be quits once the transfer of ownership has been concluded, without ending all contact between each other — this is the theme of embeddedness in Granovetter's sense (Granovetter 1985).

Objectification

The good involved in the transaction is not necessarily a physically delimited and tangible good. A good is a thing, in an anthropological and legal sense

(Hann 1998; Strathern 1999; Pottage and Mundy 2004). A service, even when it has no physical reality, can be the object of a market transaction if it has first been transformed into a thing. A car that is available for a certain use, under certain conditions and for a certain time (which defines property rights, in the Anglo-Saxon sense of the term), constitutes a good in the same sense as a car whose buyer is the sole owner for an indefinite period. These two goods — the rented car and the purchased car — are equally stabilized, delimited and definable. They have objective properties that allow the application and transfer of property rights. Materiality and physicality must not be confused. A fish sold on the Marseilles market or a week's skiing holiday bought by an English person dreaming of snow and sun are both material, in the sense that they both are things that 'hold together' and that can be appropriated because they have objectified properties.

Objectification does not preclude many interactions from taking place. This point is related to the meaning of being 'quits'. In order to construct objectified — and thus detachable — goods, a wide variety of social connections need to take place: first, upstream from the actual transaction, during the design and qualification of the good, then when market participants meet together, and afterwards, when, for instance, the seller (a notion that encompasses a collective including designers, producers and salespersons) tries to grasp the reactions of the consumer with a view to taking them into account in the future.

Singularization

This thing that 'holds together' is a good if and only if its properties represent a value for the buyer. This evaluation can be expressed as a price or a range of prices that the buyer is prepared to pay to appropriate the thing, that is, to become attached to it, to incorporate it into his or her world. Once he or she has acquired this good, the buyer becomes the owner. The transformation is twofold: not only is the good possessed by the owner, but it also becomes part of the owner's world. By saying that someone becomes the owner of something, we are referring to a market transaction, while by saying that something is a good belonging to someone, we emphasize the fact that it has been incorporated into the world of someone, of which it has become an integral part.

But how can we describe the process through which a thing is transformed into a good to which an economic agent assigns a value? How can we explain the integration into the buyer's world of a thing designed and produced outside of it? Instead of postulating a break between human agents and the things that they conceive, produce, exchange and consume, it is possible to highlight the growing importance of the processes of mutual adjustment between things and human beings, consisting of multiple iterations and engagements (e.g. Oudshoorn and Pinch 2003).

This process of co-elaboration leads to a 'singularization' of goods, an idea proposed many years ago by Chamberlin (1946) and strangely ignored by economists and sociologists. The process of individualization or singularization consists in a gradual definition of the properties of the product, shaped

in such a way that it can enter into the consumer's world and become attached to it. Throughout the process the thing — a product undergoing qualification — is progressively transformed into a good (Callon et al. 2002). The transfer can then take place. The good leaves the world of supply, breaks away from it (which is possible since it has been objectified) and slots into another world, that of the buyer, which has been configured to receive it. It becomes entangled in the networks of sociotechnical relations constituting the buyer's world.

This work of adjustment is the substance of any market transaction; only the modalities change. The issue is then the obviously varied conditions and modalities of this process of singularization of products. To understand this diversity, one has to bear in mind the twofold constraint weighing on a product if it is to become a good: that of objectification (it has to be a thing) and that of singularization (it has to be a thing whose properties have been adjusted to the buyer's world, if necessary by transforming that world). Objectification and singularization are produced simultaneously; objectified properties are those that allow the attachment of the good to the consumer.

Co-elaboration of Properties

The properties that define the good as singular and constitute its profile or identity are neither intrinsic nor extrinsic. Two symmetrical mistakes must be avoided. The first would be to say that the characteristics of the good constitute its essence and are thus independent of the world in which it circulates. The second would be to say that the good is like a screen on which social representations are projected, and that its properties, reduced to significations, are given to it by consumers or society. In the first case, the good is considered to be objectively describable, for example in an unquestionable list of characteristics. In the second, all possibility of objectification of the good is denied, and the multiplicity of points of view is emphasized. But as soon as we agree that there can be no market transaction without a process of objectification and singularization, the opposition dissolves. The purchase is not the result of a subject–object encounter, both external to each other, but of a process of attachment, which, from qualification to requalification of the product, leads to the singularization of its properties.

The co-production of singular and objectified properties requires the involvement of a large number of 'market professionals' (marketers, packagers, advertisers, designers, merchandisers, sellers, etc.) whose work is starting to be analysed and described in detail by sociologists (e.g. Barrey et al. 2000; Hennion and Méadel 1989; McFall 2004; Kjellberg 2001; Barrey 2004). This process of adjustment also involves a lengthy and systematic exploration of the networks of attachment constituting the buyer's (potential) world. One of the main requirements that designers and sellers have to meet is the study of buyers' attachments in order to be able to propose new ones. Hence, there is no irreducible opposition between the practices that produce entanglement and the market transaction that implies a break (Slater 2002). The paradox is that, to achieve the transaction through which the buyer and the seller will be quits, increasingly heavy investments in the exploration of

attachments and in their reconfiguration are necessary. In short, to expand the market it is necessary to produce more and more attachments. The proliferation of merchandise goes hand in hand with the proliferation of non-commercial attachments.

Singularizing a Good To Make It Calculable

The process of singularization consists of a series of operations resulting in the calculability of the good. Profiling a product consists in establishing a calculative space in which it can be connected and compared to a finite list of other products. In a supermarket, for example, the buyer is not required to choose a good from an infinity of goods. The shop and its material devices frame this world of possible choices by drawing a boundary between the goods displayed (on the shelves) and those that are not taken into account (Cochoy 2002). Financial markets also provide many examples of such framing. For instance, the boundary between goods included in the space of market calculation and those that were excluded (for instance, because they were equated to gambling) was a key issue at the time of the introduction of financial derivatives in Chicago's organized markets (MacKenzie forthcoming; MacKenzie and Millo 2003; Millo 2003). A good becomes singularizable, and thus calculable, only after this operation of extraction, translation and reformatting.

Singularizing a product also means linking it to other products in the same space or on the same list. This is a process of classification, clustering and sorting that makes products both comparable and different. The consumer can make choices only if the goods have been endowed with properties that produce distinctions (Cochoy 2002). In the vocabulary of professionals of qualification, this has a name: positioning. Positioning defines target consumers (singularization) while defining the field of competition. Economic life is a long series of such requalifications or repositionings. This process of linking up implies, inter alia, the establishment of metrological networks — such as quality labels or, more generally, quality standards — that measure and objectify certain properties. The supermarket is a striking illustration of these mechanisms of assortment and reassortment. In finance (an area where, as in mass retail, this networking is particularly explicit and reflexive) we meet actors who also constantly examine the relationship between products. Comparability and substitutability are at the heart of methods for pricing derivatives and of arbitrage techniques (Beunza and Stark 2004; MacKenzie 2003b). The more complex a product is, the more its marketing poses problems in terms of singularization. The product wavers between a high level of singularization (weak substitutability) and a high level of standardization (strong substitutability).

The good has been placed in a frame with other goods. Relations have been established between them, leading to new classifications that allow forms of comparison: the good can finally be calculated. All these operations constitute the material base for the extraction of a result (a price, a classification, a choice). This relationship between the singularization of a product and its calculability is particularly visible in the case of complex (or 'exotic') derivatives in

financial markets. The complex product — a contract drawn up by a bank for a corporate client who needs protection against particular financial risks — is reduced to a pricing formula that assesses the value of the product in relation to various elementary components. The product is thus objectified and singularized: objectified because the properties qualifying it have gradually been stabilized (and described in the pricing formula); singularized because these properties have been determined in such a way as to adjust to the client's needs. This mathematical formula generates a number that can be compared to other numbers. It is singular and comparable, and consequently calculable, but in a way that is immediate (Lépinay 2003).

Distributed Calculative Agencies

The calculability of goods naturally implies the intervention of acting forces. When we talk of calculative agencies, we have in mind all the operations that make goods calculable, in the sense defined above. As we have seen, these operations involve both humans and non-humans. This leads us away from standard theories of action, which reserve agency for humans alone, towards the notion of distributed agency. Since this notion is now fairly widespread (see, for instance, Suchman 1987; Norman 1988; Hutchins 1995), we will present it very briefly, with particular emphasis on the fact that agencies' calculative capacities are linked to their equipment, which is distributed. This characterization will enable us to consider asymmetries of calculation — a key issue in the analysis of commercial struggles.

Distribution and Equipment

Calculative agencies are not human individuals but collective hybrids, 'centres of calculation' (Latour 1987). These agencies are equipped with instruments; calculation does not take place only in human minds, but is distributed among humans and non-humans. The notion of 'distribution' is crucial. It does not mean that flesh and blood human agents, faced with difficult calculations, use tools, without which they would never be able to accomplish their tasks. The discussion on the role of double-entry bookkeeping (DEBK) in the rise of capitalism (Carruthers and Espeland 1991; Vollmer 2003) gives good illustrations of the type of interpretation that we wish to avoid. Yamey (1949), criticizing Weber's and Sombart's theses, affirmed, for example, that without entrepreneurship a simple bookkeeping tool could not have led to the rise of capitalism. It is not double-entry bookkeeping that calculates, he says, but the human agent, in this case the entrepreneur who decides to use it. The point of view that reduces calculative tools to their instrumental dimension is common in economics, including in less orthodox approaches (institutional, evolutionary). For Herbert Simon, it is because agents are faced with complicated tasks that, to relieve their brains and enhance their performance, they conceive of tools, create rules and routines or set up organizations to calculate for them. By introducing these new entities (routines, rules, conventions) into the

analysis, the economists who have followed Simon have unquestionably achieved a great deal: they have extended actors' cognitive capacities by redistributing their brains, at least implicitly. Studies on cognition and distributed action, as well as research in the anthropology of science and techniques (especially that based on actor-network theory) have extended this approach: knowledge and action are never individual; they mobilize entities, humans and non-humans, who participate in the enterprise of knowledge or in action. This participation is active and can only exceptionally be reduced to a purely instrumental dimension.

Thus, in the case of double-entry bookkeeping, two extreme and opposite interpretations can be excluded: in the first, DEBK is a particularly efficient tool (for calculating profits) in the hands of human agents who have total control over their objectives and their actions; in the second, it is an instrument of economic rationality, which, simply by being used, imposes on the agents a coherence and a calculating logic that is beyond their reach. (In one case, it is the tool that is instrumentalized whereas in the other it is the agent.) The notion of distributed calculative agency is more demanding than these simplifying alternatives. It makes it possible to escape this dilemma (see also Miller 2001). The entrepreneur, who is supposed to calculate his or her profits, does not use DEBK for more precise, quick and exact calculations, conceived of well before the tool itself. It is the twosome consisting of the entrepreneur and DEBK that conceives of this calculation and performs it. We could even say that DEBK, simply by being there, and available, proposes this calculation to the entrepreneur, who accepts the 'invitation' — a movement that resonates with the notion of affordance (Gibson 1979) — and asks DEBK to perform the calculation.

Financial markets abound with innovations, experiments and interventions that make the variety of distributed calculating agencies visible. Alex Preda (2003, 2004) has shown how the introduction of the stock ticker altered the equipment of traders and spawned new ways of calculating decisions in financial markets. Since prices could be known in real time in distant places, the development of new forms of arbitrage and speculation was encouraged. The continuous display of prices allowed the development of techniques of graphic analysis of price variations, i.e. chartism. The ticker did more than provide information: it constructed data that, owing to their format, produced specific effects of cognition and action (as shown by Jack Goody with regard to lists and tables). Likewise, the trading room of a modern investment bank produces heterogeneous forms of calculation that depend on the devices used by traders to distribute their calculative activities: trading robots, telephones, pricing tools, etc. (e.g. Beunza and Stark 2004).

Asymmetries

The activities of design, production, commercialization, prospecting, purchasing and consumption involve a large number of calculative agencies that can cooperate with, compete with or be disconnected from one another. Asymmetries are formed, and can evolve and change. Our definition of

calculation directly implies that of calculative power. A calculative agency will be all the more powerful when it is able to: a) establish a long, yet finite list of diverse entities; b) allow rich and varied relations between the entities thus selected, so that the space of possible classifications and reclassifications is largely open; c) formalize procedures and algorithms likely to multiply the possible hierarchies and classifications between these entities. As this calculative power depends on the equipments that agencies can rely upon, we can easily understand why it is unevenly distributed among them.

This unequal distribution is well illustrated by the relationship between supply and demand in a supermarket. As seen before, the consumer is never alone or isolated: he or she is distributed and makes assessments that involve references, brands and all sorts of preformatted and precalculated information supplied by the supermarket and its arrangements. Packaging, shelves, proximity between products, brands, labels and promotions — all of these constitute a system of distributed cognition that participates actively in the process of qualification and singularization of products (Lave et al. 1984). Consumers may also perform tests at home, with friends and family, and discuss the results. They can read consumer magazines that guide their choices (Mallard 2000). They are engaged in relations of prescription that multiply their reflection and action. They can enter the supermarket carrying a shopping list, a real cognitive prosthesis (Cochoy 2002).

However, irrespective of how strong the consumer's calculative agency that evaluates the attachment of goods to his or her own world may be, it remains weak compared with the calculative power of supply, which is highly equipped, at least in the case of mass retail (see Cochoy 2004). From the design down to the display of products on shelves, series of professionals are involved, all exploring the consumer's distributed world the better to integrate the product into it by playing skilfully on the product's qualifications. Facing the consumer are a multitude of professionals armed with computers, studying his or her movements and calculating margins down to the last cent or gram.

From this example we should not conclude that asymmetries always develop in the same direction (with supply dominating demand) or that they are final. In certain cases it is the buyer or the customer who is in a dominant calculative position, as in certain subcontracting markets or financial situations. In other cases, an agency initially in a weak position gradually acquires tools enabling it to change the balance of power and to become more active in terms of qualification and singularization. The struggle for more autonomy or recognition often involves efforts to acquire calculative equipment.

This changing geopolitics of calculative powers is probably more visible in finance than elsewhere. One of the typical characteristics of finance is that it makes substantial changes possible in the relative sizes of actors. These changes may seem remarkable if we compare them to other, more industrial forms of capitalism. As soon as they enter into the realm of high finance, stabilized forms of capital can be challenged by new actors capable of deploying calculative tactics whose impact is sometimes devastating for established interests (e.g. MacKenzie 2003a, 2003b).

The same type of trials of (calculative) strength can be observed in a supermarket. Buyers very frequently use the calculative tools that are more or less explicitly proposed to — if not imposed on — them. They abandon their own autonomy. Of course, they continue to calculate, i.e. to evaluate their attachment to a good, but they do so by means of tools designed by the seller. By walking down supermarket aisles, inspecting shelves and reading labels, consumers continue a calculation that was started and framed by qualified professionals. But they can reverse the relationship. In this respect it is appropriate to remember the useful distinction between planned and impulsive buying. The former corresponds to greater autonomy for the consumer, whose equipment, prepared in advance, depends less on that provided by the shop. By contrast, the latter corresponds to a heteronomous position in which the consumer, strolling along without any specific intention, becomes an appendage of the calculative device created by the experts of marketing and stock (e.g. Licoppe et al. 2002). A particularly striking example of such a move from a position of autonomy to one of heteronomy is studied by Pierre Bourdieu in his analysis of the real estate market: the encounter between the seller and the potential buyer becomes a tug of war in which the former tries to impose his or her own calculative tools on the latter — often with success (Bourdieu 2005). In these encounters, whether it is the consumer hesitating between two packets of smoked ham or a couple anxiously following the real estate agent's calculations to assess their debt capacity, radically different values are confronted. When a compromise is reached it has to be interpreted as a compromise not on values but on the instruments that calculate values.

A new way of conceiving of the relations of domination running through and structuring markets thus emerges, by considering that they are inscribed in relations of calculation. It is indeed increasingly difficult to conceal the power struggles behind commercial transactions when the means of calculation employed become the subject of experimentation (e.g. Guala 2001). When they are experimented with, analysed, interpreted and evaluated, asymmetries of calculation are rendered, at least to some extent, explicit and can fuel debate (to make something explicit is to make it disputable). The increasing role of consumer unions or user organizations, the obligation for firms to take environmental criteria into account in their own calculations, and the proliferation of open source software are good examples of this kind of explicitness.

Calculated Encounters

The very concept of a market is problematical because, in the general sense of the term, it implies the existence of an abstract space in which aggregate demands and supplies encounter and cross one another and, through successive adjustments, end up defining what is commonly known as the market price. In this conception, the abstract market is a structure that formats (and explains) each individual commercial transaction. It is consistent with Cournot's famous comment: 'We know that economists understand by the

term market not a particular place where sales and purchases are carried out but a whole territory in which parties are in such free intercourse with one another that prices are levelled out easily and promptly' (Cournot 1838: 55).

For a long time this abstract conception of the market occupied a key position in economic theory, which explains why, as several authors have noted, concrete markets became invisible and were seldom studied. This conception also introduced logical and theoretical difficulties, especially when it came to explain mechanisms of aggregation of supply and demand. The case of Walrasian *tâtonnement* is an example. The problem is not only that an exceptional set of conditions has to be verified in order to produce a Walrasian type of environment (Guerrien 1999), an environment that cannot even be found in Walras' mythical source of inspiration, the Paris Bourse (Walker 2001); it is, above all, the 'elliptic' treatment of the aggregative mechanism (nothing is said, for instance, about how actors avoid trading at 'false' prices) that lies at the level of the pure theoretical explanation in Walras and most of his successors (see Teira Serrano 2001). Referring to the market in this way (a logical explanatory principle in which concrete sociotechnical devices and procedures are put aside) is certainly depriving oneself of the explanatory key required to describe the mechanisms of aggregation and their effects.

To overcome this problem, we need to switch to an opposite perspective and take as a point of departure the transaction itself, that is, not the macrostructure of a hypothetical market but its 'microstructure', a particularly useful concept borrowed from economics. The notion of microstructure is convenient for referring to a set of transactions between a limited number of agents whose respective positions and relations depend on a particular architecture of exchange. In economics, this notion has been proposed explicitly as a tool for studying price-setting mechanisms and is used widely in the analysis of financial markets, although it is not limited to these areas (e.g. Madhavan 2000; Spulber 1999).

One of the most original contributions of market microstructure research and other disciplines, such as experimental economics, is to have revealed the key part played by mechanisms of encountering. This kind of research focuses, to a large extent, on how to render explicit exchange procedures and their aggregation effect. And this research is not only of a purely academic kind: this way of rendering markets explicit is stimulated by the rapid growth of new market technologies (e-commerce, automated trading systems in financial markets, etc.) which put microstructures to the test of R&D and market design (e.g. Guala 2001). These forms of research make explicit what we call the algorithmic configurations of markets.

Algorithmic Configurations

The use of computers in the construction of markets has changed our conception of markets (Mirowski 2003). The rapid growth of e-commerce and the automation of financial markets (e.g. Domowitz and Wang 1994) have highlighted a fact that is well known but seldom studied: the existence of a multiplicity of practical forms of confrontation between supply and demand.

Complex double auctions (bidding for sales and purchases), Dutch auctions, bilateral structured negotiations, posted offers and free-form bilateral discussions, among many others, clearly indicate the diversity of possible configurations (see also Smith 1989). These configurations highlight a specific calculative dimension of markets that is distinct from the calculability of goods or the constitution of calculative agencies. For instance, a double auction can be described and analysed independently of the goods to which it relates and the calculative capacities of the agents involved. From this point of view, the experiments by Gode and Sunder with 'zero intelligence' traders are significant (Gode and Sunder 1993; see also Mirowski and Somefun 1998; Mirowski 2002). They suggest that, in an experimental double auction, the convergence of traders towards predicted prices and quantities will happen whether traders are human subjects or simplistic robots. In other words, the formulation of rules or, more exactly, algorithms that make it possible to identify the agents authorized to engage in a transaction and to describe the order in which bids and offers should be taken into consideration, and the way of matching them, are essential elements in establishing aggregate regularities in prices (what economists call 'price discovery'). Likewise, and this time in real markets, the automation of financial markets and the organization of e-commerce require a detailed definition and analysis of algorithmic procedures. These algorithms cannot be described and defined in an abstract way, independently of the material conditions of their enactment.

To illustrate a concrete algorithmic configuration, take the case of the Paris Bourse and the different options envisaged and discussed throughout its automation (Muniesa 2003). With the introduction of automated quotation in this market in the late 1980s, actors were faced with a multiplicity of possible strategies and with controversies characterized by an entanglement of computational and political issues. An important choice consisted, for instance, in opting for either an electronically assisted open outcry or a fully automated exchange. These two options, translated in different algorithmic configurations, recast the balances of power between bankers and stockbrokers differently. The import of CATS (Computer Assisted Trading System) into the Paris Bourse required a process of adaptation and sociotechnical engineering that needed to render these balances of power explicit before the system could be applied.

Defining algorithmic configurations by rendering them explicit is as much about accuracy of prices as about their fairness. The debates about how to set closing prices are good examples of the difficulties of such a task. The implementation of a call auction for closing prices at the Paris Bourse, for instance, brought a particular code of legitimacy in price formation (Muniesa 2000, 2003). This particular algorithmic configuration was introduced as a response to the 'manipulation' of closing prices, a manipulation that was somewhat costless in a continuous auction closure. Other algorithmic solutions were possible, such as the reduction of closing prices to an average of the last tradings, but did not produce the same aggregative effect. As shown by the history of statistical devices, essays in aggregation are often a political matter (e.g. Desrosières 1998; Didier 2002).

The case of the Paris Bourse cannot be reduced to a handful of technical innovations. Types of orders, double auction protocols, tick size, allocation priorities, degrees of anonymity and circuit breakers are just a few among the multiple elements of this complicated configuration. They not only frame the expression of supply and demand, but also determine the way in which prices are generated. This 'price discovery' is an intricate matter because it has to take into account (but how?) a large number of bids and offers that have to be linked (but how?) to one another. Instead of being reducible to two aggregate schedules that intersect at a point, or instead of counting on a disembodied and elliptic auctioneer — 'out of reach of all control' — the Paris Bourse combines different algorithmic configurations based on technical and organizational material devices, and on embodied competencies. These algorithmic configurations are real sociotechnical arrangements. 'The market' does not exist independently of them. Analyses of concrete and abstract markets were dissociated for a long time, simply because the mechanisms of aggregation and composition of supply and demand, organized within these arrangements, were disregarded and simplified to the extreme.

Calculating and Calculated Algorithmic Configurations

Algorithmic configurations are calculative devices in the sense that we have given to this term. They: a) circumscribe the group of calculative agencies that are to be met, by making them identifiable and enumerable; b) organize their encounter, that is, their connection; and c) establish the rules or conventions that set the order in which these connections must be treated and taken into account (formats, queues, etc.). Algorithmic configurations calculate encounters differently, depending on the way in which they perform these operations; each concrete market corresponds to a particular mode of organization (and calculation) of the connection between singular supplies and demands.

The space of the supermarket calculates encounters. A shopping mall, with its access roads, alleys, juxtaposition of shops, series of shop windows and queues at certain points, constitutes an algorithmic configuration that organizes the encounter of calculative agencies. Mailing lists, coupled with telephones and directories for contacting potential customers, are devices that can also be analysed as sociotechnical algorithmic configurations (Mallard 2004). With new information technologies, the power and diversity of encountering technologies are amplified. Nigel Thrift (2004), who uses the notion of 'address technologies' to denote these algorithmic configurations, talks, in this respect, of a real qualitative break. Information technologies allow physically distant and desynchronized entities to meet and constantly renew that encounter (barcodes and SIM cards are two of the examples given by Thrift). With these technologies, configurations become objects in their own right into which research and experimentation can be conducted.

These configurations of encounters do not always contribute directly to price determination. In supermarkets, for instance, prices are displayed and constitute one of the elements of the qualification of goods for sale — even

if, in certain cases, as in Osaka in Japan, bargaining is possible and even encouraged. Prices are not the outcome of this particular calculative device (the supermarket display), but part of its setting. Other algorithmic configurations (especially the ones that organize the encounter between producers and distributors) intervene at some other point with specific pricing outputs. Although auctions constitute a paradigmatic example of price-setting algorithmic configurations, they are far from being the only ones.

The notion of 'algorithm' should not be taken in its metaphorical sense. First, this is because — and this is a lesson learned from the history and sociology of computing (e.g. Collins 1990; Schaffer 1994) — a computer is literally an organized social space, as markets are. Second, it is because this notion does justice to the idea that more than one 'logic' exists for markets and even for capitalism. An algorithm can be analysed as a logical program. As a program, it implies the existence of several solutions that can be attained by following a concrete set of instructions contingent on a specific situation and/or task. It can be qualified as logical in so far as it is deduced from a simple principle of action (Knuth 1996: 59). It matches the description of the multiplicity and materiality of complex but ordered operations through which singular demands and supplies run.

These algorithmic configurations of encounters are not structures that already exist in which calculative agencies simply circulate and develop. Agencies may, and often are, engaged to varying degrees in the design and negotiation of architectures that organize market encounters. An extreme situation is one in which a calculative agency almost entirely controls this 'design' work, as in the case of electronic market platforms. Financial markets offer the example of an intense struggle between the designers of market technology (conceived of as places of encounters). The architectures of the algorithmic configurations, that the different exchanges propose to produce liquidity and deprive their competitors of it, are at the centre of the competition between them (Lee 1998; Muniesa 2003). Similar phenomena concern e-commerce websites or customer catchment areas for mass retail. In other cases, calculative agencies can only marginally alter the configurations that organize their encounters, since none of them are able to impose their own definition on the others.

From Algorithmic Configurations to Abstract Markets

The identification and clarification of algorithmic configurations (also called microstructures, provided that the technical dimension of material devices is included in the concept) that organize the encounter between distant and desynchronized supplies and demands raise two types of question. The first concerns the relationship between the choice of certain forms of organization and the effects produced by those choices on the functioning of the aggregate market (and especially on price setting). The second concerns the conditions of validity of the abstract models that provide a synthetic and stylized description of the functioning of markets as calculative devices. In both cases, the question of the relationship between concrete and abstract markets is posed.

The diversity of possible options for organizing the encounter between supply and demand inevitably raises the question of what the consequences are of the choice of a particular option on the functioning of the market as a whole. Empirical studies on the microstructure of financial markets tend to show that these effects are largely undetermined and, in any case, difficult to foresee and evaluate. There is, for example, no method for opening a trading session that can be considered as the best option applicable to all financial exchanges (Domowitz and Madhavan 2001). The exemplary work of Alan Kirman (2001) on a very different type of market, the Marseilles fish market, enables us to take this kind of analysis even further. This study shows that there is no good reason to think that we can deduce — in any way other than statistical analysis, simulation and experimentation — the effects produced by a certain configuration of microstructures on an aggregate market.

In the case of the Marseilles fish market, the aggregate market can be described as competitive whereas the various agents' behaviours are openly non-competitive. In other words, there is clearly something that can be described as an aggregate market, but its structure — if we stick to the word — is the result obtained by the economist when he or she composes a large number of singular market transactions, and not the frame defining the rules and format of those transactions. In this case, Kirman imagines a simulation that is based on the particular characteristics of the algorithmic configuration of the Marseilles fish market: transactions are bilateral, with undisclosed and non-negotiated prices; the prices set for the same category of fish by the same seller for different customers vary widely; and the encounters between buyers and sellers are regulated by powerful networks of loyalty. It is by taking into account these particular characteristics in his simulations, that Kirman manages to explain why and how the composition of the different micro-transactions results in the constitution of a competitive aggregate market.

Kirman's simulation shows two things in particular. First, abstract markets exist and their production requires efforts in abstraction, in this case performed by an economist. Second, the description of the abstract market that sums up a particular concrete market involves the 'explicitation' of algorithmic configurations implemented in that market and the analysis of their calculative effects. If the economist can talk of (abstract) markets, it is because markets can be considered as sociotechnical algorithms whose shape and properties he or she analyses. To 'abstract' — and it is important here to consider abstraction not as a purely intellectual stance but as a practice — is a calculative activity, which explains why and how economics (as a calculative discipline) can play a role in the description of markets, i.e. in making explicit their calculative features.

Conclusion

The purpose of this article is to render the calculative character of markets theoretically less controversial and empirically more realistic. In order to do

so, we propose to revise the notion of calculation, without eliminating it. Economic calculation is not an anthropological fiction, precisely because it is not a purely human mechanical and mental competence; it is distributed among human actors and material devices. As this article shows, this applies to markets. A market can be described (at least partially) as a collective device for the evaluation of goods. This calculation is possible only if goods can be calculated by calculative agencies whose encounters are organized and stabilized to a greater or lesser degree.

This approach emphasizes the diversity of possible forms of market organization. A good can be rendered calculable — that is, individualized and objectified — in a multitude of different ways. Calculative agencies are as numerous and diverse as the tools they use and the hybrid collectives to which those tools belong. Algorithmic configurations where calculative agencies and calculable goods come across each other are also multiple and diverse. These three elements (goods, agents and exchanges) constitute three possible starting-points for exploring markets as complex calculative devices. Mass retail (because it is obsessed with the singularization of products) and financial markets (because they are obsessed with processes of price setting) provide ideal cases for studying these three forms of economic calculation and the modalities of their combination.

The framework developed in this article is by no means exhaustive, but we believe that it opens many opportunities for research. We wish to conclude on one of its main potentialities, which, in our opinion, is the capacity to renew the political questions and criticisms generated by economic markets. One of the most recurrent questions concerns the market's capacity to grasp issues involving justice and equity, but also its propensity to destroy any form of personal relationship. Behind the variety of forms of calculation, which are the main result of our analysis, is there not a single implacable logic, one that is becoming hegemonic: that of calculation as the only possibility for action? Our approach enables us to introduce certain subtleties and nuances into the answers to this question. First, it highlights the fact that there are several ways of calculating values and reaching compromises. Second, it makes empirically observable and theoretically analysable the fact that certain agencies are exempt (or prevented, depending on the point of view) from calculation, whereas others concentrate the most powerful calculative tools in their own hands. Third, it suggests that open discussions and even public debates on the way of organizing calculations (or on the way of excluding certain modes of calculation) are possible. In short, it restores to markets the political dimension that belongs to them and constitutes their organization as an object of debate and questioning.

Finally, this perspective is also attentive to the increasing role of research and experimentation in the conception of markets, their regulation of or intervention in their modes of functioning (see also Callon 1998). More and more actors are involved (or are likely to be) in this experimental work and this investigative activity. Note, moreover, that all the practices referred to as experimentation encompass a wide range of activities. These include laboratory work (for example, in the context of experimental economics or

consumer research) and also tests on a large scale (for example, in the context of financial engineering or marketing tests). In all cases, and to varying degrees, tests are organized to clarify the functioning of the market and act on its organization. Consequently, everything that is said on technical democracy, on public discussion and on the participation of groups interested in technical controversies (Callon et al. 2001; Barry 2001; Callon 2004) applies to the calculative capacities of markets as soon as they become the object of collective inquiry.

Note

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