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Economic calculation. Frameworks and performances

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1 Introduction

Within the scope of recent studies in economic sociology, Social Studies of Finance have emerged which implement the methodological research strategies and theory perspectives of *Science and Technology Studies* for the exploration of global financial markets and banking. Thus sociological knowledge, which was developed in the course of research on the interactive and technical emergence of (scientific) facts in the area of *Science and Technology Studies* (STS), is transferred to the observation of economic processes. The social studies of finance are by no means homogeneously structured; rather they make reference to various approaches within STS as well as theories of practice. This paper investigates the central role of economic knowledge, the performativity of economic representations, and the local practices that are imbedded in these forms of knowledge (e.g., Callon, 1998; Beunza and Stark, 2004; Knorr and Brüger, 2002; MacKenzie, 2006; Kalthoff et al., 2000). Against this background, a detailed discussion will be offered with regard to economic calculation and its technically framed infrastructure as exemplified by risk management in the banking sector.

Whenever large international banks grant loans to companies, they are faced with the problem of having to discern and carefully consider whether the loan can be paid back or not. In order to obtain an appraisal about the future solvency of companies, bank staff reviews their economic performance and financial standing from various angles. Firstly, they transform documents (e.g., balance sheets, profit and loss accounts) they have received from their clients and other institutions (e.g., business consultant firms) into

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their own model of economic representation; this transformation serves as a precondition for calculating a multiplicity of economic ratios. Secondly, they personally call on their (potential) clients in order to gain an impression of the company's current state and the prevailing atmosphere. They try, as one corporate banker explains, "to get an idea how the process is running [...] how the production facilities are organized, what the ambience is like, and how the workers move around". It is these direct observations of economic reality that allow "*sinnliche Gewißheit*" (Hegel, 1807, Kapitel I): the economic life-world is just as bank staff perceives it. Thirdly, they prepare a credit proposal that summarizes the results to date: purpose, maturity, term, and composition of the loan and a description of the potentially financed object, possible collaterals and internal evaluation (ratings), the company's credit standing and its economic-financial situation, various information about the debtor (address, duration of the client-bank relationship, etc.), as well as handwritten comments by the signing bank staff member vested with the relevant credit authority. This credit proposal will then be negotiated within the subsidiaries of large international banks and among the subsidiaries and headquarters of each bank.

Two departments within the corporate organization of the bank are responsible for the final loan decision: corporate banking and credit risk management. Corporate banking prepares the transaction, negotiates the loan transaction modalities with the corporate client and observes and evaluates the company's business outlook on relevant markets. Risk management performs a corporate evaluation exclusively based on transformed corporate figures. In doing so, risk management functions as "a kind of supervisor" (quoting a department manager) for the corporate banking department. The official and legally coded representation of the loan process then stipulates an organizational work division, the prolongation of the loan preparation and of the decision-making process. This implies that the loan process has two components: on the one side there is the corporate banker (also referred to as the corporate account representative) who has direct contact with the client available, canvasses loans and clients, creates a 'relationship of trust' and brings in a certain amount of self-interest regarding the loan transaction since he or she receives a bonus for each transacted loan. On the other side there is the risk analyst, who is interested solely in the company's written documentation and thus in the construction of the loan.

In this article, practices of calculation are regarded as epistemic practices. Epistemic practices concern the circumstances, events, artifacts, etc., that are taken for granted within the routines of everyday life. At the same time, however, they are themselves routinized practices in their own rights, and their performance is framed by technical devices, procedures, other ac-

tors, and negotiations.[1] Consequently the attempt to describe and delineate objects of knowledge is stabilized by technical and other means: they embed these objects in so far as they portray them and make them emerge as such. Needless to say, these technical means are not conceived as neutral objects, but as theory-induced instruments of representation.

In this sense, epistemic practices explore economic objects such as the solvency of a corporation, the development of markets and prices, the dynamics of foreign exchange trading, etc. The banking industry's central object of knowledge—the *economic time* (Kalthoff, 2005, p. 71) of actors and investments—has two implications: firstly, it does not present itself in an unequivocal, immediately recognizable way, but remains vague and even ambivalent, demanding some effort in order to become recognizable. Secondly, the sense of an economic investment is not simply given, but is acquired gradually by the risk management. This article will explore different aspects of economic calculation as it is implemented in risk management. It sketches the general technical framework of risk calculation with regards to global software and banks' data management (§3).

The next section debates and substantiates the assumption that a company's technical devices of calculation constitute the company in the first place. It will also show the constructivity of economic figures that result out of work on the economic category itself (§4). Then I will analyze negotiations among risk analysts in the subsidiaries and headquarters of large international banks concerning those calculated figures. The analysis of the written reports' verbal interpretations aims at shifting the concept of calculation from 'calculating something' to 'calculating with something.' Taking advantage of this relationship between interpretation and representation as well as between speech and writing, the article analyzes practices of communication and cognition in which ideas about and expectations of the future development regarding the bank's economic strategy are involved (§5). Both concepts—'calculating something' and 'calculating with something'—can be traced back to Heidegger's work on the social role and the social function of technology in modern societies. In a first step, Heidegger's position will be closely examined in order to ascertain its relevance for sociology of calculation (§2).

I gathered the empirical material which will be documented in this article through ethnographic fieldwork: about six months of participant observation in two subsidiaries (Warsaw, Sofia) of two international banks:

[1] The distinction between objects assumed to be self-evident in routine courses of action and those facing inquiry by means of epistemic practices can also be found in Heidegger (1957b). According to him, instruments are "to hand" ("*zur Hand*") and are used for specific purposes, to which they themselves unquestionably make reference. But in situations when that object's reference is disrupted, they themselves become questionable and have to be restabilized (cf. Heidegger, 1957b, p. 74).

I observed, among others, social actors in their daily routines of calculation, working on written documents, preparing them for internal negotiations, discussing the results of their calculation on a local and global level. Additionally, I conducted interviews—formal expert interviews as well as "friendly conversation(s)" (Spradley, 1979, p. 80)—in other subsidiaries and in the headquarters of international banks (Prague, Paris, Frankfurt/Main, London, Munich). Whenever the interviewees agreed, the interviews were recorded and transcribed later; when the interviewees disagreed to recording I wrote a protocol afterwards based on my "jottings" (cf. Emerson et al., 1995).[2]

2 Considerations on technology

Within sociology, various approaches examine the role that technology plays and the way it functions. Posthumanist social theories symmetrize the sociological view inasmuch as they assign non-human actors a significant share of the performance of actions. Decentering the subject and the role it plays in sociology is central for these approaches. The invention of technical artifacts to which humans delegate the performance and simplification of functions and options as well as values and routines, etc., dissolves the simple dichotomy between human and non-human actors. Basically, it is about conceiving human agency as a technically framed and performed interaction. *Actor Network Theory* (Latour, 1987) follows a strong, semiotic concept of culture and an analogy between actors and artifacts, which frames the interactive occurrence qua "interobjectivity" (Latour, 1994). In the field of German sociology, Rammert (cf. Rammert, 2008) developed the concept of "technography" within which the concept of "distributed agency" is a key for the empirization and even culturally sociological reformulation of Actor Network Theory. In this approach, connections to social constructivism in STS are drawn, which describe the reciprocal and complex conformities and adjustments between human actors and technical artifacts as well as their integration into social worlds as processes of interpretative stabilization and flexibility (cf. Oudshoorn and Trevor, 2003). In these studies, the autonomy of technical artifacts is confronted with the actors' knowledge of how to implement these for specific purposes without assuming a stable and permanent configuration. Although human actors are framed by technical artifacts, they still determine, invent, and produce them. In recent studies, one may also diagnose a reorientation towards human agency that takes into account the material and technical figuration of human life-worlds (e.g., Pickering, 1995).

[2]For a detailed account of ethnographic research and its relation to sociological theory, cf. (Kalthoff, 2003, 2008); on the pitfalls of transcription, cf., e.g., (Hammersley, 2010).

This article pursues a different strategy: in order to explore the logic of (material) practices in risk management departments of international banks, it goes back to Heidegger's work on the philosophy of technology. This involves some difficulty, as his position on technology is somewhat ambivalent: his writings include critical, anti-technological thoughts, belief in human control over technology, and romantic notions about craftsmanship (cf. Dreyfus, 1993, p. 303ff.; Dreyfus, 2002, p. 163f.). In addition, his idiolect virtually invites criticism. The purpose of this article is therefore not to develop a totalizing view of technology and calculation; this could hardly be achieved, neither conceptually nor empirically. Rather, the purpose is to give substance to a constitution theory perspective and thus take up the debate on the relevance of Heidegger's ideas for sociology (cf. Weiss, 2001). This article primarily makes use of Heidegger's later writings and includes interpretations of his work by Dreyfus (1992, 1993, 2002), Dreyfus and Spinosa (1997), Seubold (1986), and other scholars.

2.1 Philosophical Standpoint of Technology

The point of departure in Heidegger's considerations is his dissatisfaction with anthropological and instrumental explanations of technology and technical artifacts. Heidegger states that neither of these positions is wrong; they are, however, inadequate for grasping the essence of technology and for explaining how human beings are involved in technology. According to Heidegger, the essence of technology can only be understood if one considers how something that is absent is brought into existence and thus is being made present. Hence, his primary concern is to understand the essence of technology as a "way of revealing" ("*Weise des Entbergens*"; Heidegger, 1954a, English: p. 12, German: p. 16); "revealing" [*entbergen*] brings forth the invisible or the concealed and therefore into existence. For Heidegger, technology has consequently to be perceived not just as a means, but rather as a "challenging" ("*Herausfordern*"; Heidegger, 1954a, English: p. 14, German: p. 18) of nature, through which, for instance, energy is produced,—exhibiting the revealing essence of technology. In Heidegger's language, artifacts are "set" [*gestellt*] through this challenging, i.e., brought forth and placing the educed artifacts in a different context. For Heidegger, there are three key arguments for understanding the signature of modern technology:

The first argument states that modern technology is like an ordering system ("enframing", Heidegger, 1954a, p. 19; "*Ge-stell*", 1957b, p. 23; Jaeger, 1994, pp. 24–45) that treats every present human or non-human entity as a resource that is used, challenged, and transformed. It is an unquestionable, hardly explainable occurrence that places everything—repeatedly and constantly—in connection with this ordering system (cf. Jaeger, 1994, p. 31). The paradigm for this ordering process and efficiency is energy being "chal-

lenged" by a hydroelectric power plant: as a natural object, a river does not produce electrical energy out of itself; the river is set by the power plant, which transforms it to function as a drive for the turbines (cf. Heidegger, 1954a, p. 19f.). The relation between the power plant and the river implies two important strands of argumentation formulated by Heidegger: for one, it shows that every element is set by another element—both human beings as well as non-human entities. This "ordering chain" (Jaeger, 1994, p. 29: "*Kette des Bestellens*"; translation H.K.), which knows no end and is conceived as a circuit, equals an "endless disaggregation, redistribution, and reaggregation *for its own sake*" (Dreyfus and Spinosa, 1997, p. 163, italics in the original). Furthermore, the example also demonstrates that, according to Heidegger, modern technology reduces every object to its material quality and function (e.g., to the generation of hydraulic pressure), making it instantly and utterly available. This feature of modern technology does not exclusively apply to technical hardware, but is equally applicable to information and organizations. In his later writings, the computer-aided processing of information becomes Heidegger's paradigm for technology and modern science (in particular physics; cf. Heidegger, 1957a; Dreyfus and Spinosa, 1997). This notion is associated with the perfection of technology, which shows itself in a "thoroughgoing calculability of objects" (Heidegger, 1957a, p. 121)[3] and therefore becomes "orderable as a system of information" (Heidegger, 1954a, p. 23).[4]

In his second argument, Heidegger suggests a perspective that redefines the subject-object relation: it is not the power plant that has been built into the Rhine River, but the Rhine River that has been built into the power plant. The Rhine River is what it is due to the power plant—and not the other way around. Within the ordering system of enframing, which regards every human being and non-human entity as a resource, modern technology constitutes the world, indicating how objects should be treated and how an effective ordering of resources is organized. Heidegger (1954a, English: p. 17, German: p. 20f.) uses an airplane to illustrate this point: the nature of an airplane cannot be inferred from its material characteristics or its ability to take off, but through the connection into which it has been placed. This is an international system of transport in which human beings serve the purpose of filling the machines that are ready for take-off (cf. Dreyfus and Spinosa, 1997, p. 306). Applied to economic calculation this adds up to the following: the implementation of a calculation aided by technical means stands in a chain of transformations that mobilizes uniformity, reification, and control. With this in mind, economic representation and its technical infrastructure are geared towards producing and circulating economic calcu-

[3] "*durchgängige [...] Berechenbarkeit der Gegenstände*" (Heidegger, 1957a, p. 198).
[4] "*als ein System von Informationen bestellbar bleibt*" (Heidegger, 1954a, p. 26).

lations. Comparable to the notion that it is not the wheel that determines rotation, but rotation that determines the wheel (cf. Jaeger, 1994, p. 34), it is assumed here that it is not the risk that causes economic representation and decision, rather it is the calculation and its media that cause the "revealing" of the risk—and thus the market, the business, and the return. This means: modern technology shows us how objects should be treated and how an effective array of resources is organized. And economic calculation does not bring objects that already exist into a visible order; rather, financial objects (such as "cash flow", "EBITDA", "return") do not begin to exist until they have been subject to the process of calculation (cf. Seubold, 1986, p. 87ff.).

Heidegger's third argument extends the concept of calculation beyond dealing with numbers: "To reckon, in the broad, essential sense means: to reckon with something, i.e., to take it into account; to reckon on something, i.e., to set it up as an object of expectation" (Heidegger, 1954b, p. 170).[5] Or he writes: "We take them [the circumstances, H.K.] into account with the calculated intent aimed at specific purposes. We reckon in advance with a specific outcome. [...] This kind of thinking continues to be calculation even if it does not operate with numbers and does not set a mainframe computer going. Calculative thinking computes" (Heidegger, 1959, p. 12; translation H.K.).[6] It is important in this context that Heidegger distinguishes "calculative thinking" [das "rechnende Denken"] from "contemplative thinking" [das "*besinnliche Nachdenken*"] and "representative thinking" [das "*vorstellende Denken*"] (Heidegger, 1959, p. 13; translation H.K.). "Calculative thinking" characterizes planning and research (Heidegger, 1959, p. 12) with the objective of being able to precisely know, measure, and define something; "contemplative thinking" is distinctive for the human being as a "*meditating being*" ["*sinnende(s) Wesen*"] (Heidegger, 1959, p. 14; italics in the original; translation H.K.) and demands effort and care. "Representative thinking" is an activity that places something else in relation to oneself and structures it according to that representation or imagination; it also bridges the difference between calculative and contemplative thinking (cf. Buckley, 1992, p. 235). In (Heidegger, 1950), Heidegger writes: "'We get the picture' [literally, we are in the picture] concerning something. This means the matter stands before us exactly as it stands with it for us. 'To get into the picture' [literally, to put oneself into the picture] with respect

[5] "Rechnen im weiten, wesentlichen Sinne meint: mit etwas rechnen, d.h. etwas in Betracht ziehen, auf etwas rechnen, d.h. in Erwartung stellen" (Heidegger, 1954b, p. 54).

[6] "Wir stellen sie [die Umstände, H.K.] in Rechnung aus der berechneten Absicht auf bestimmte Zwecke. Wir rechnen im voraus auf bestimmte Erfolge. [...] Solches Denken bleibt auch dann ein Rechnen, wenn es nicht mit Zahlen operiert und nicht die Zählmaschine und keine Großrechenanlage in Gang setzt. Das *rechnende Denken* kalkuliert" (Heidegger, 1959, p. 12). Cf. also (Heidegger, 1957a, p. 168).

to something means to set whatever is, itself, in place before oneself just in the way that it stands with it [...]" (Heidegger, 1950, p. 129).[7] To represent something (in the sense of *vorstellen*) is therefore formulated as "to set out before oneself and to set forth in relation to oneself" (Heidegger, 1950, p. 132).[8] In this concept of picture or image, the activity of producing finds expression via representing (*vorstellen*). To represent means, accordingly, to know something and to have it to hand, to shift relations and thus to structure reality.

As has been shown, Heidegger (1950) emphasizes the empirical relevance of cognitive representations: in this sense, to represent something means to bring it forth by means of this thinking. Wittgenstein (1978) also speaks about the relationship between calculation and assessment and that assessments are configured by calculations, which at the same time are assumed to be stable and unambiguous. "Thus we judge the facts by the aid of the calculation and quite differently from the way in which we should do so, if we did not regard the result of the calculation as something determined once and for all" (Wittgenstein, 1978, p. 325).[9]

2.2 Performation, Performance or Performativity?

But what does this mean for economic sociology in general and the social studies of finance in particular? What do researchers in these areas learn about the practices of economic calculation and computation if one embeds them in a "culture of framing" (Martens, 2001, p. 303)?

Or, in other words, has the theoretical framework of the *Social Studies of Finance* not, for instance, already been mapped out by Actor Network Theory (cf. Callon, 1998)? In more recent research in the area of financial sociology, it was Michel Callon (1998) who made a conceptual suggestion that has been widely received (e.g., MacKenzie, 2003; MacKenzie et al., 2007). Callon essentially develops two arguments: (1) Economic action is embedded in economic theory and its models of economic processes; models of economic theory therefore frame and format economic action. The tendency of economic sociology to observe economic practice and economic theory separately and to treat economic practice as an ontologically independent sphere of the social world is replaced by a symmetrical perspective, which in turn protects (economic) sociology from becoming an ancillary

[7] "[W]ir sind über etwas im Bilde. Das will sagen: die Sache selbst steht so, wie es mit ihr für uns steht, vor uns. Sich über etwas ins Bild setzen heißt: das Seiende selbst in dem, wie es mit ihm steht, vor sich stellen und es als so gestelltes ständig vor sich haben" (Heidegger, 1950, p. 82).

[8] "[D]as vor sich hin und zu sich her Stellen" (Heidegger, 1950, p. 85).

[9] "Wir beurteilen also die Fakten mit Hilfe der Rechnung ganz anders, als wir es täten, wenn wir das Resultat der Rechnung nicht als etwas ein für allemal bestimmtes ansähen" (Wittgenstein, 1978, p. 325).

discipline of economic theory that directs its attention toward, for instance, actor's preferences. (2) Callon emphasizes: "*homo oeconomicus* does exist, but is not an ahistorical reality [...] He is the result of a 'process of configuration' and is 'formatted, framed and equipped with prostheses which help him in his calculation...'"(Callon, 1998, pp. 22, 51). Within the context of *Actor Network Theory*, Callon is concerned with the embedding of human actors in a network of non-human means of calculation that have been formatted by economic theory and which allow the actors to perform calculations, to formulate prognoses, and thus evoke actions. Callon's *homo oeconomicus* is therefore one link in a chain of inscriptions (i.e., representations) and socio-technical constellations. Here lies the social location of the "capacity of economics in the performing (or what I call 'performation') of the economy" (Callon, 1998, p. 23). According to Callon, it is not the responsibility of sociology to present a more complex version of *homo oeconomicus*, but to comprehend "his simplicity and poverty" (Callon, 1998, p. 50).

The concept of "performation" (Callon, 1998, p. 23) in particular has recently been questioned (cf. Fine, 2003; Mirowski and Nik-Khah, 2008). This term, which is translated as "performativity" in the Anglo-Saxon discussion can, among others, be traced back to the French branch of research shaping an *économie des conventions*, including authors such as Laurent Thévenot, Robert Salais or Olivier Favereau. This branch of research examines, among other things, how economic actions can be coordinated in such a way that they result in, or their entities are shaped into, a form that is acknowledged as information and thus circulates as a legitimate generalization of particular circumstances (situations, theories, persons, etc.). This is described as "investment in forms" (cf. Thévenot, 1984). Callon's suggestion to speak of a *performation* means formatting an entity through another.[10] To borrow from Latour (1994): economic practice is linked to the laboratories of economic theory by an invisible thread; the formulas developed years ago are maintained and communicated by an industry of programmers, engineers, and managers that determines, channels, and authorizes the framework that again determines the actions performed by economic actors.

In contrast, according to Austin (1992), the cultural theory perspective towards the concept of performativity refers to an entity's realization in and through media (such as language and body) as well as to the performative character of practices that, while they are being performed before an audience, change as they are repeated (cf. Wirth, 2002). The term is

[10]Cf. also Heidegger (1957a, p. 124): "Yet while information in-forms, that is, apprises, it at the same time forms, that means, arranges and sets straight". Morgan has studied the 'investment in mathematical forms and models' in more detail (cf., e.g., Morgan, 2001, 2011).

especially important in gender studies (e.g., Butler, 1988), in the production of language (e.g., Krämer, 1996), in the analysis of the performance of self (e.g., Goffman, 1974), as well as in the effect and logic of performative media (cf. Carlson, 1996). Whereas culturally theoretical research is oriented towards microanalytically situating performativity in different contexts of practice or media, Callon's *performation* marks a macrodivision of the world in which the one world (economic theory) penetrates the other world (economic practice). *Actor Network Theory* conceives this penetration as an inscribing translation through which the social, nature, or technology can be transferred into processed writing (e.g., Latour, 1999). This semiotic cultural concept places the things it describes into a different ontological order, while culturally theoretical perspectives of performativity do not perform this reduction. The *performation* theory therefore is distinguished from other discourses on performativity inasmuch as it makes the coding of knowledge in theoretical economic models the point of departure for the analysis of economic practices: what is supposed to be observed is the formatting of the economic world, which corresponds (is supposed to correspond) with the models of economic theory.

With respect to Callon's concept, it should be further noted that it tends to exclude the critical examination of the inconsistencies concerning economic theory (e.g., Cullenberg and Dasgupta, 2001) and thus to curtail the sociological view on the practice of economic theory construction as well as to ignore other social dimensions of economic practices. Nevertheless, the viewpoint taken here is that the framing function of both theoretical economic knowledge (which, for instance, is incorporated in technologies, bank products, and instruments of representation) and governmental regulations (which format the market) are important for sociology of economic action. At the same time, however, it makes sense to rehabilitate the social actors who seemed to disappear in the dynamics of inscription.

In contrast to *Actor Network Theory*, a constitution theory perspective as outlined here—according to Heidegger—is capable of transcending an analysis chiefly stressing the semiotic culture of socio-technical networks.[11] The performance of risk calculation, for example, makes reference to its own performativity, which in turn brings forth economic objects by dint of ordering, categorizing, and computing them. This does not occur independently of human action, but it also does not occur through human action alone. Technical things are means in the hands of human actors, playing an essential part in the way technical things function at the same time (cf. Jaeger, 1994, p. 68; Heidegger, 1954a, p. 16). Looking at it from Heidegger's perspective, both of them are put into context by the process of producing

[11] Mitchell (2007) has shown how economics is able to shift the border between informal contexts, non-markets and markets, and thereby create its own objects.

reality. Furthermore, the empirical perspective which is taken up in conjunction with a constitution theory approach allows the actors to act and speak as well as to observe and describe the performativity of economic representations within the scope of risk management as a calculative practice. In this approach, sociological theory construction takes place on the basis of empirical observations whose purpose is not to verify a theoretical model, but to generate and even irritate theory.

3 Technological systems of updating: a framework of risk management

An initial look at the risk management department of a bank shows this department to consist of computers on risk analysts' desks, which are linked up to a computer network. From the perspective of the risk analysts, computers and programs are mere tools that make applications possible. They did not construct the computers, nor did they program the software. They are computer users, i.e., users of software programs which, in fact, have been developed and installed by the responsible group division for risk calculation purposes. While risk analysts are tied to their workstations, their data are mobile and can be moved and transformed by analysts. The activities of risk analysts are individualized, since generally they are responsible for individual companies or branches. Direct professional connections with other risk analysts on a horizontal level are rare; the most contact takes place between the analysts and the corporate account representatives of the respective company or branch.

The computer-based data that the risk analyst can draw on concern companies and branches as well as the economic development of regions and countries. The computer not only makes data available by means of which the analyst can compute economic developments of a company, it also supplies the formats in which this is carried out. Thus cash flow, ratio or projection sheets are specific technologies of economic representation by means of calculation, which in turn require and assert effects of homogenization and simplification.[12] The risk analyst consequently operates on the basis of forms into which his organization has implemented knowledge. This also means that work on the form of calculation is not complete until the moment it is applied; negotiations on the implications of the calculation models or on the implementation of other calculation methods do not take place within risk management but in other bank departments.

Updates of computer programs and the daily backup of information are performed by a backup network into which the banks have integrated their

[12]This equally applies for staff whichs works in the areas of FX, bond, or derivative trading or investment banking. Here, computer-based calculation tools for technical analysis are installed onto the computers of the traders who operate with them.

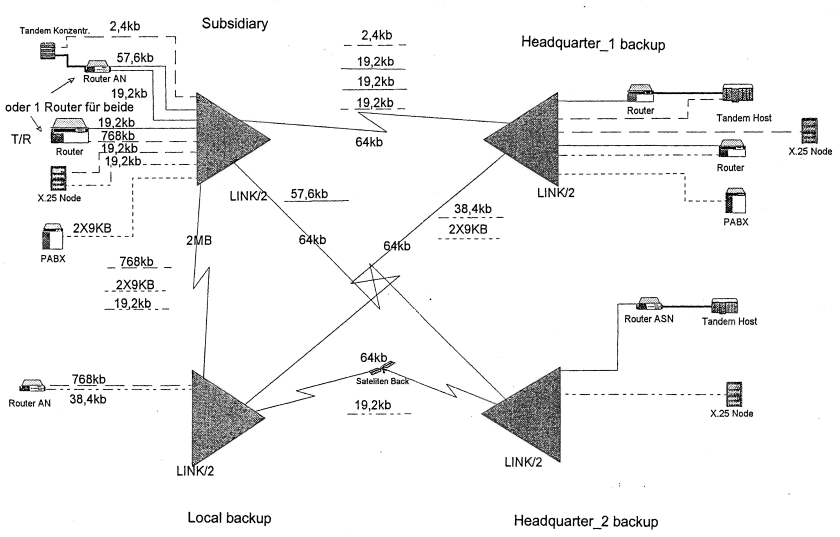

FIGURE 1. Backup Network

subsidiaries. The technical infrastructure of data transfer documented in Figure 1 shows how in the second half of the 1990s, a local internal network (Subsidiary) is linked via routers with the networks of the main data center (Headquarters).

Without being able to fully discuss the technical details here, the following structural traits should be emphasized. The entire backup system of this subsidiary is designed for maximum system stability. This is evidenced by the fact that backups of the entire stock are made at three geographically distributed locations—in a local data center and in two central data centers. Secondly, the way in which the link between the individual networks (Subsidiary, Local backup, etc.) is depicted—using the symbol for lightning (↯)—indicates that there is no direct connection between the individual networks; rather, there is a connection via an additional medium (telephone network, dedicated line or satellite). It becomes clear that two different kinds of remote data transmissions are used: the organization's own telephone network or dedicated lines between the organizational units, and a satellite connection between "Local backup" and "Headquarter_2 backup". In case of interrupted data transmission pertaining the telephone network or dedicated line, the backup between the local data center and the central data center is secured by a data transmission connection that operates

stand-alone, irrespective of the cut off telephone network or the dedicated line. The bandwidth indicated regarding the connection to the data processing centers (Headquarter backups), which from today's point of view seems to be low for the transfer of large volumes of data, refers to mainframe computers in the central data centers that use the network connection more efficiently than conventional computers. Finally, the X.25 node technology is a protocol family developed in the 1970s that enables secure connections via unreliable telephone networks. Even in the 1990s it is plausible to use this technology, as the subsidiary company whose backup network is being represented here operates in Eastern Europe.

It remains to be noted that the updating of computer programs also takes place via these connections: a variety of programs (for acquiring customer data, for carrying out transactions, for calculating and representing economic objects in the various departments, etc.), whose maintenance is also partially delegated to external companies (Bloomberg or Reuters, for instance), are loaded from the central data center via the local data centers onto the individual computers of risk managers and analysts. In the process, regional distinctions are also carried out that take into account the *in situ* requirements and legal conditions. Thus, one program for the logging of customer data provides for 'branch-specific screens' for subsidiaries in New York or Paris.

First, the purpose of this system is to make data globally available in a uniform format and at a wide variety of locations. Secondly, its purpose is not only to make data accessible, but also to enable the data to be processed. This permanent and simultaneous overwriting, backing, overwriting, etc., of data takes place in a simultaneity that makes sure that all of the employees within the local networks who use a specific computer program are up to date and at the same time participating in the generation of the program. Of course—and this is not surprising—there are a variety of computer programs used in the different operative and administrative divisions carrying out the banking business. The following section deals with the use and the performativity of computer-based calculation tools that are implemented in the banking industry for the calculation of creditworthiness.

4 Technology of writing: The constructivity of figures

The calculation and thus the work on the document begins when the company's annual financial statements arrive at the risk management department and the risk analysts manually transfer the bank's balance sheet. Risk analysts refer to this activity as "making a structure". They use it to describe the restructuring and reordering of the company's original balance sheet. In this initial step of transforming figures, individual items are reevaluated, summed up, and rearranged. It often happens, for instance, that the short-

or medium-term liabilities of a company are recalculated or that individual items on the original balance sheet are summed up beneath one item in the structural balance sheet. "Making a structure" therefore means identifying and assigning items as well as performing simple arithmetic operations. In this way, the corporate balance sheet becomes the bank's structural balance sheet; a new company is calculated out of the former company; a self-description becomes a public description. In terms of this study, this activity delineates the reconstitution of the company, since the banking procedure reestablishes its economic framework. With reference to (Foucault, 1975, p. 195ff), it can be pointed out that this activity creates order and methodically places diverging representations into one format: category by category and element by element, the documented wealth of a company is unraveled and rearranged in linear form. This new configuration of economic representation enables recombinations, i.e., different calculations that lead to even further economic representations.

The technical basis regarding the activity of "making a structure" is a calculation program (a so-called data sheet). Here is an example:

Example 1. A risk analyst is sitting in front of his computer and has loaded the input mask into which he wants to enter the new intermediate figures of a company. He clicks on "new customer statement" and enters the date of the annual statement. He then has to opt for an "accounting standard"; he selects "local commercial law" and not the US-GAAP. He begins entering the figures in item 111 ("cash equivalents"). He types the number "662," presses the "return" key, and mutters "zap". The sequence of numbers appears flush-right in the virtual table. The analyst's eyes wander from the original balance sheet to the monitor and from the monitor back to the original balance sheet. This continues category by category, line by line, input field by input field. Several categories are made up of different items in the original balance sheet, thus, e.g., item 321 ("staff expenditures"). The analyst first enters the actual staff costs, to which he then adds the ancillary staff costs and the social welfare expenditure. He controls the accuracy of the input using various items. But the computer also produces warnings. The risk analyst says: "Here's a warning message" and points his finger at a field. He comments further to the ethnographer: "The computer says that the own funds from the previous year plus/minus the total chance in own funds, which results from the overall profit and loss statement, has to result in own funds in the current year".

Example 1 gives an account of a routine activity that can be observed almost on a daily basis. It makes clear that the human actor mediates between a company's written document and the computer, which projects a virtual document onto the monitor. By entering one number after the other,

the risk analyst enables the computer to carry out arithmetic operations for which the program is designed. This transfer of the original balance sheet is necessary in order for the computer and the program to interact. At the same time, the company's written document loses its function of supplying the content for the calculation. It becomes superfluous, since it no longer has an influence on the computer's calculation. It is filed away and no longer plays a role in the loan assessment. Thus "making a structure" means transferring the available system of figures of a company into the bank's own scheme and in doing so, generating new documents that represent the central basis for all further calculations, negotiations, and decisions. In this way, restructuring produces the central written banking documents.

Routine activity is interrupted by cases open to question, which has been the case when one risk analyst hesitated when she came across an amount labeled "additional earnings". She assigned the amount to a variable item, i.e., to an item she defined herself, and asked the account representative to clarify this item with the company. The corporate banker told her later that it was an "inter-company loan". In another case the risk analyst was only able to clarify a difference shown on the computer by "trial and error until it worked" and the computer no longer indicated a difference. In concrete terms, one is concerned with establishing the item "fixed assets current year". These "fixed assets" are established through an arithmetic operation: fixed assets (previous year) plus addition to fixed assets minus net disposal of fixed assets minus depreciation results in fixed assets (current year). The problem now does not consist in carrying out this calculation, but lies in knowing which values need to be taken into account for the respective categories (addition to fixed assets, disposal of fixed assets, depreciation).

Even though the calculative steps as well as the values are given, the calculation does not work out. The risk analyst takes a first step and corrects an error. He mistakenly combined depreciation and amortization. He now enters the two numbers separately in the income statement. In a subsequent step he gets hold of a list which contains detailed information about the movement of the fixed assets. He adds those items together that are designated disposal of fixed assets; he then subtracts the depreciation of the disposal of fixed assets from these items and finally gets the amount indicated on the computer (item 612). He proceeds in a similar manner with the additions to fixed assets. The difference identified by the computer came about because the risk analyst initially pursued another philosophy of representation by not categorizing the "down payments for investments" as an "addition". He addressed this issue by saying: "It is often represented very differently. One has to see how it functions by trial and error". This quote articulates a pragmatic attitude towards an applied representation and a tendency to stick to the computer specifications. Furthermore, these

scenes show how strongly the computer-based format—in particular the formula fields of the calculation table—intervenes in what is taking place and attracts the risk analysts' attention; they harmonize their ensuing steps according to the format's specifications and calculations, i.e., they add to it, delete numerical values or ignore the "warning". Different participants used the same words to express that they had to make repeated attempts and had to see if they "got it right": "attempting" and "getting it right" clearly show that "making a structure" is not a simple transfer of figures from one calculation scheme to another, but consists of work on fitting those calculation categories since the schemes are based on them. In other words, it shows the constructivity of the figures.

Work on the company's reconstitution can also go so far as to invent corporate figures. In this case, risk analysts constructed a so-called pro forma balance sheet: a balance sheet was subsequently drawn up for a company that had previously belonged to a group of companies and whose balance sheet was not reported independently. According to the risk analyst, the new company's balance sheet was removed from the old company, and they now acted as if the new company had been independent for several years. They were actually operating on the basis of very unstable figures, and they did not really know whether they would be able to get it right.

An indispensable condition concerning the rules of these calculations is the work on the economic category, which ranges from "capital turnover" and "gross turnover surplus" to "FX adjustments". The categories are calculated aided by equations that are often characterized by simple arithmetic operations. The "return on investment" may be cited as an example: The financial equation for "return on investment" is to multiply equity ratio by equity return. Both factors refer to the company's monetary goals, namely "earning money" and "securing the source of earnings" (Baetge, 1998, p. 522); economic discourse draws attention to the earning power and the financial stability of a company, which can be accounted for in this way. From an economic point of view, equity return indicates how efficiently a company has worked; in this respect, it expresses corporate equity. Cash flow, equity capital, and total capital in turn are also fabricated structures, for instance, resulting out of the calculated relation between operating result, standard depreciation (or appreciation), and provision for (or dissolution of) pension accruals (as in the case of cash flow I). The basis of this ramification and interdependency regarding these calculative dimensions form the ratio systems that combine the financial equations with one another and, in the case of the "Dupont Formula", assemble them in the shape of a pyramid to create a "key ratio" (Baetge, 1998). Regarded in computational terms, the equations are created through operations of partitioning, substitution, and extension (cf. Küting and Weber, 2000, p. 27f.). The applied equations

produce an effect: they show how economic representations can be treated and combined.

In risk analysis, the calculation of economic figures is first and foremost starting up a calculating machine that has been manufactured and programmed at other locations and that is constantly updated. Employing its calculations, this computer transforms and calculates the empirically existing data material in a way that makes other dimensions of a company available. This work on the document not only minimizes contact with empirical reality, it produces completely new starting points and perspectives. This means: it produces objects in the medium of representation and calculation, and in doing so, presents them to the physical eyes of bank staff. Associated with this is a shift towards the internal plausibility and accuracy of the economic representation.

5 Technology of talk: the structure of economic discourse

As has already been demonstrated, calculative thinking in terms of Heidegger becomes visible within the context of transforming corporate figures and in dealing with requirements specified by computer-based calculation programs. In this section, calculative thinking will be placed into the context of those discussions and examinations that have been conducted with respect to the calculated economic and financial standing of a company and with reference to the transaction decision. As has been explained elsewhere (cf. Kalthoff, 2005, 2011), these verbal discussions take place within and among the participating organizational units—subsidiaries (local level) and bank headquarters (global level). At the local level, the participants are the risk management and corporate banking departments; at the global level, generally, the only participating department is risk management. These discussions have either symptomatic or systematic form. Symptomatic forms include, among others, conversations in the hallway, in passing, or bilateral telephone conversations and e-mail messages. Systematic forms include those kinds of meetings structurally scheduled within a company, such as, e.g., credit committee or telephone conferences. Empirical observations were performed during negotiations in subsidiaries (local level) as well as between the subsidiaries and the bank headquarters (global level) which took place in the form of telephone conversations and telephone conferences.

Each of the locations stands for a different perspective of observation: on the one hand, an acquired (strong) identification with the credit transaction and thus with the company (local side); on the other hand, an observation of this difference, doubt regarding the accurate representation of the figures, and an identification with the bank's specifications (global side). The following remarks highlight the issue of how the actors proceed when they

discuss the credit construction and the calculated figures based on the written documents that have been generated. I will elaborate this issue using several examples:

Example 2 (Local risk management 1)**.** The department manager of the risk management department and a staff member (a risk analyst) are sitting in the office of the department manager. The department manager asks the staff member to tell him what speaks in favor of the loan. The risk analyst says that they are not dealing with a steel producer but with a company that processes and coats steel. He adds that over the past several years the company has invested approximately 30 million euros in modernizing the production process. [...] The department manager then asks how things look with the competing companies. The staff member says that steel products from Asia do not constitute competition and that the demand for steel products in Poland is very high. But the department manager interjects that this may be the case today, and points out that compared with Western Europe, steel consumption in Poland is lagging far behind. The risk analyst raises the objection that the company also exports its products to Western Europe. The share may be only ten percent, but the products are also competitive in Western Europe. [...] After both of them spent some time silently leafing through the documents, the staff member says: "Liquidity is a weak point of the company." "Yes, you're right", the department manager agrees.

Example 2 documents a negotiation one often comes across in risk analysis. Bent over a stack of papers, the participants formulate their (critical) inquiries and comments expressing their agreement and their concerns. They articulate what they read, and they listen to what they read but which is articulated by others. In this case, the conversation was prestructured by the fact that both the risk analyst and the department manager—a widely traveled risk specialist for a large bank—basically have a positive attitude towards the loan transaction. This scene documents that the participants proceed according to a question pattern: they inquire into

- the company's economic environment and conditions (for instance, the purchase of steel),
- the market situation (for instance, demand and competition), and
- the company's financial situation based on ratios (for instance, return on equity, liquidity).

The reason why the risk analyst questions these areas is because they are specified in the bank's so-called rating sheet, an evaluation pattern. These

items are being formulated during the interaction process and answered on a case-by-case basis. Thus in this interaction process, the account of the assessed company is prestructured by a document that itself is part of the economic evaluation of the company. The items to be assessed throughout the rating sheet are the central theme of the conversation.

But who is speaking here when risk analysts address these items? At a first glance, it is certainly the risk analysts themselves who speak. As they articulate the questions, they are spokespersons of the first order. On the other hand, however, they are also spokespersons of the bank, i.e., of that central department that drafted and tested the risk pattern. In this respect they formulate questions drafted by others concerning this application. They are the spokespersons of risk management.

Example 3 (Local risk management 2)**.** The department manager says: "What kind of a rubbish heap is this? Why are we even doing this? With a 'C,' it's a potential valuation adjustment customer." The risk analyst justifies himself and says: the 'C' is the result of the customer's bad information policy but the transaction itself is safe. And "the company does not have the money at its disposal". The department manager then asks: "And where does the money go?" The risk analyst replies that the money goes into a special account.

Example 3 illustrates the following: a company wants to set up a credit line in order to buy PLN (Polish złoty). The bank's risk is that the company cannot buy two million PLN if the market price for PLN is strong. There are two possibilities for the transaction: first, a spot transaction, which—oriented towards the daily exchange rate—is implemented by the bank's foreign exchange dealers. Secondly, the bank can make use of an FX forward if the amount to be set up is deposited in a special account for which the company has only very limited rights of disposal. In the course of the discussion, a decision is made in favor of this second alternative, and the global markets department is instructed to find another market participant who wants to exchange the amount at an exchange rate of 1.9–2.1 at an appointed time.

The significance of the economic evaluation becomes clear. The bad grade ('C') is offset against a "secure transaction" and thus neutralized. This is accomplished by hedging the transaction in such a way that the loan commitment and the right of disposal are separated. Thus if the economic risk remains manageable and the bank acts as the central player, then a positive decision can result from a bad credit rating.

Example 4 (Between local and global risk management)**.** In the following, we write "Sub" for the subsidiary (local level) and "Hq" for the headquarters (global level).

Sequence 1.

Hq: [...] And so only the new cars are included in the balance sheet.

Sub1: Yes.

Sub2: Yes.

Hq: Because last year they had quite a high capital expenditure, more or less working capital. I assume, to increase their business potential.

Sub2: The capital expenditure is in connection with the cars. Yes, that's right.

Hq: With the cars, okay [...]

Sequence 2.

Hq: [...] We will take an amount of foreign currency receivable from that board?

Sub: Yes.

Hq: Alright. And we will get that portfolio reviewed?

Sub: Sure.

Hq: Okay. Then these payments will be made into accounts in Sofia or in the branches?

Sub: Yes, in Sofia, because we have all the accounts technically here. Everything is done over here.

Hq: Okay. And if there are receivables which are not being paid we would have the right to replace these with other receivables of our choice?

Sub: Yes of course.

Hq: Okay [...].

Sequence 3.

Sub: [...] Something else is said about the leverage ratios on page 24. Good, on the whole that's natural, total liabilities versus equity. We have to make sure that this company stands at the lower end with respect to ratio. I mean this in a positive way. At the lower end if we compare it with the entire industry. And we have a projection that sees an increasing reduction of this leverage ratio. And then there will be a capital increase of 290 million złoty. Then there's somewhat more space again.

Hq: Yes, but that's the overall leverage situation. You know, we have a country lore that says ten percent of the equity capital. Those are our boundaries. And that is clearly above that.

Sub: Wait a minute [he is using a pocket calculator and goes through some documents]. Let me have a look. We're at eighteen percent. And that's too high for you?

Hq: Yes. And it's primarily this loan. We don't want to get rid of any plain vanilla loan products [...]

The three sequences in Example 4 demonstrate another scheme. The risk managers from bank headquarters inquire into details about the calculation, management, the market situation, and the transaction and, as the third sequence documents, also cast doubt on the calculation that has been performed. What is important here is that to them, the economic account presented by the local side in the written documents is not evident. They approach the representation with an element of doubt regarding the accurate portrayal of the company's situation as outlined by the local side. By reviewing the economic account, they check the soundness of the argumentation, the accuracy of the calculation, as well as the hedging of the transaction. This can also lead to the deconstruction of the local side's calculation model. What also becomes obvious in the third sequence is the discrepancy between local market and global strategy: the spokeswoman for the global side reminds the local risk analysts of the general business strategy not to set one's stakes on simple investments and bank transactions but on complex ones. The sequences also highlight the hierarchical structure of the discourse: in the first two sequences, a local department manager and a risk analyst justify themselves to a higher-level manager from the bank's headquarters (global risk management). Similar to a courtroom situation, their expressions of confirmation are brief.

The scenes documented throw light on the systematic elements concerning processes of consensus that are carried out in a large international bank on the basis of written documents: (1) the prestructuring of the discourse through an assessment instrument which directs the actors' attention; (2) the non-economic legitimization of economic decisions, that is, the discursive use of non-economic figures of argumentation; (3) the deconstruction of economic calculations and thus the argumentative preparation of grounds that can lead to a rejection of the loan application; and (4) finally, doubt with regard to the accuracy of the portrayal, which leads to detailed inquiries. These four elements recur in the verbal negotiations in various constellations and variations. Furthermore, they document which form the social phenomenon of "calculating with something" assumes in this area.

6 Conclusion

This article dealt with the question of how sociology of calculation can be worked out using the example of economic calculation and thus empirically analyzing it. We have argued that the impetus for sociology—but also the particular challenge—consists in taking up a constitution theory perspective in which it is assumed that (economic) entities can be produced by ways of calculative methods and processes. Conceiving the implementation of economic calculations as the (technically based) constitution of entities and as a reciprocal relationship between the world of figures and the imagination has consequences for sociological research: first, the mathematical realism characteristic of, e.g., work in the area of sociology of knowledge (e.g., Mannheim, 1929; Bloor, 1973) has to be rejected. Mathematical realism assumes the existence of entities that are only reordered and portrayed by calculation processes. In contrast, the constitution theory perspective suggested here argues that the written processes of mathematical operations produce the objects of the economy; it is the processes of calculation that cause these entities (e.g., cash flow, EBITDA, risk) to exist in the first place. For the sociology of economics and finance, the development, implementation, and use of these "operative modes of writing" (Krämer, 1997) marks an empirical research program.

Secondly, the theory of visibility as formulated by accounting research (e.g., Hopwood and Miller, 1994) needs to be complemented. It is argued in these studies that hidden elements of the economy can be made visible using a scopic technology of calculation, and that exercising control becomes effective through this process of being made visible (cf. Foucault's model of panoptism; Foucault, 1975).[13] What these studies neglect is the other side of visibility, viz., a vision that is equipped with power and knowledge and that is directed toward (self-)knowledge. It is important for sociology of calculation to tackle the elaboration of a theory concerning this kind of economic "worry about oneself" (Foucault, 2004) as an independent mechanism of calculative practice.

Thirdly, the concept of practice requires clarification and conceptualization. As a rule, in the areas of economic sociology or accounting studies it is accompanied by a concept of action that implies individual, goal-oriented actors with intentions. This kind of concept of action only allows a limited view of issues concerning the practice of calculation, the constructivity of sets of figures, the function of technical artifacts, or the role of the human body. Thus an advance is being made for a culturally sociological concept that does not individualize action, but locates it in the performance of social practice, which in turn exhibits physical and technical, representational

[13] The term "scopic technology" loosely follows Foucault (1975); for the notion of "scopic system", cf. Knorr (2006).

and reflexive dimensions. There are culturally sociological concepts available that might serve as the basis for follow-up research.

The research perspective suggested does not imply a (neo-)Kantian turn in the sociology of calculation or a revitalization of the old debate over realism versus relativism with reference to the reality of economic entities or facts. Rather, it perceives work on the written document and the calculation as a practice of representing in its own right. In this way it follows observable practices and empirical relations; it implies an awareness of the calculative framework and thus the question of what is included in or excluded from the calculation through work on the category.

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