polish sociological review 3(211)'20
ISSN 1231 – 1413
DOI:10.26412/psr211.04

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Sociological Aspects of the Statistical Research Process: Toward a Sociology of Public Statistics

Abstract: The statistical process is a multifaceted, socially immersed research process. Statistics as a research activity is—and statistics as a product are—influenced by a variety of factors, covariates, and participants/stakeholders in data generation, analysis, dissemination and use. The aim of this paper is to identify and systematize key elements of the socio-cognitive status of statistics and of relations between statistics and society. To this end, a conceptual meta-model of the statistical process, involving an interwoven "logic of method" and "logic of action," provides a framework for the exploration of statistics from the perspective of sociology. Given that social, cultural, and political conditions affect the quality of statistical products and the status of statistical institutions, sociological study seems especially well suited to dealing with the complexity of the issues involved. To be successful, however, advances in the sociology of statistics are also desirable.

Keywords: sociology of statistics, statistical process, statistical system, quantification, sociologization, status of statistics

Introduction

The problem of the relations between statistics and society has only recently become the subject of relatively systematic considerations from the perspective of sociology, specifically the sociology of statistics. It is a rather newly established field of research,[1] though concern about issues common to sociology and statistics dates to the turn of the nineteenth and twentieth centuries (e.g., Porter 1995). Durkheim's efforts to create "statistical sociology" as an extension of his analysis of suicide data were the most prominent in this respect. Statistical sociology involved statistical typologies in terms of deviation from an "average type," modelled after Quetelet's idea of "average man" (in an anthropometric sense, but with faith in the regularity of statistical events). This field of research has recently been identified with the sociology of quantification in the broad sense, as a subfield of sociology (Berman and Hirschman 2018; Mennicken and Espeland 2019) resembling Paul Lazarsfeld's concepts (1961).

At a glance, all this can be reformulated for research purposes as an issue of reciprocity and influence between processes taking place in parallel on two levels: the cognitive and the practical. When the contextual effects of their institutional environment are taken into

[1] According to Starr (1987), the sociology of statistics was originated by Sternlieb (in 1973).

consideration, the concept of a statistical system becomes more appropriate, as will be discussed below. The level of cognition includes the creation of information through a complex statistical process, including not only statistical research but usually also implicit assumptions regarding quantification, which are then transferred to the knowledge system. Interactions between the cognitive and practical aspects of the statistical process lead, at least potentially, to a conflict between the economic, political, and social interests involved.

As Alonso and Starr (1987) have already noted, this makes statistical research products susceptible to the influences of organizations and groups (including official institutions), and thus their objectivity is threatened. Key stakeholders in the statistical process—researchers, statisticians, data users, and data providers—represent various interests, which according to Duncan et al. (2011) rarely align and so must be reconciled by the responsible organization. The data-stewardship organizations—statistical agencies, national statistical offices, data archives, trade associations, unions, credit bureaus, and health information associations—expand the list of stakeholders and their respective interests, at each of the major stages of work with data: Capture, Storage, Integration and Dissemination—CSID (Duncan et al. 2011: 3). Whenever the impartiality of the statistics would be jeopardized, however, there is room for sociological reflection and empirical analysis of potential sources of distortions at any stage of the CSID process, by any of its stakeholders. For instance, at the data "capture" stage, the interviewer–respondent interaction can be treated as a prominent object of such reflection. According to the cognitive methodology of survey research, the interaction should encompass a sequence of operations: from the design of cognitive questions and the setting of standards to interviewing and testing (Biemer et al. 2004 [1991]; Groves et al. 2004; Sułek 2001). Another example concerns the non-probability sample design needed in situations where probability sampling is deemed infeasible—as in the sampling of rare or so-called hard-to-reach populations, for instance, in regard to the homeless or persons exhibiting illegal behavior, and in connection with growing concern about protecting the respondents' confidentiality, given that public-use files are becoming more complex and vulnerable to disclosure (Kalton 2017; Okrasa 1994). Such situations are becoming common as the integration of datasets from different sources (including administrative and big data) becomes the main methodological remedy to compensate for the effects of non-response and other non-sampling errors in survey-based estimations (Lahiri 2019).

Thus studies should be comprehensive, involving issues already occurring in the initial phase of the operationalization of the statistical research process as part of the quantification process: from the choice of the language and concepts (the "statistical semiotics"), through "numbering" (assigning numbers), to communication and education (formal and informal) in the spirit of "number ethics." Treated here as the essence of the statistical process, the quantification process is specific because its distinguishing feature is the communication system that emanates from a particular code (including "forms of statistics") associated with the institutional system of social organization ("forms of social organization"), among other things. Hence, there is an acutely felt need for a comprehensive approach, integrating the approaches developed in different disciplines. This study addresses the problems considered important from the perspective of the sociology of statistics that has emerged in just over a quarter of a century.

The structure of the study is as follows: the following part, (the second) is devoted to issues that are important from a sociological viewpoint. In the third part, the issue of quantification is discussed, with an emphasis on convention as a sociologically important, though usually overlooked, aspect of quantification and measurement. The third part also contains an overview of approaches to quantification in the literature. The fourth part has two layers. Various issues related to the image and position of statistics in society are presented and then certain elements of the sociology of statistics are discussed. In the fifth part, selected findings are summarized and the issues worth addressing as part of a future research agenda are indicated, including determinants of the effectiveness of statistics and its status in society, the state, and the economy.

Statistics and Society—Sociologization and Related Issues

Basic Assumptions About the Statistical Process

Statistics, perceived in substantive or content terms, is usually defined as a body of knowledge consisting of registered and presented quantitative data.[2] As a scholarly discipline, it is supplemented by algorithms for data compilation and analysis, including the choice of indicators, the design of models ("statistical" and "econometric"), methods of data generation, the construction of databases, and so forth. One version of such an approach was developed, for example, by the pioneer of the French school of the sociology of statistics, Alain Desrosières (2011: 59). Statistics should consist of a subjective and comprehensive approach to the statistical process as a social process. Moreover, it should be implemented by competent experts, that is, by statisticians possessing methodological awareness based on knowledge of the available techniques and methods (Platek and Särndal 2001).[3] A meta-model of the dual logic of influences by both types of factors—the cognitive-methodological and pragmatic-operational—which jointly determine (or construct) the full statistical process, is outlined in Figure 1.

A statistical process is envisioned, in such a holistic meta-model, as a dynamic system composed of two types of elements—socio-operational and cognitive-methodological—which jointly generate a sequence of stage-specific products. While the operational sequence "*dikd*" (data, information, knowledge, decision) properly describes the typical conduct of statistical research, the actual conditionalization of choices concerning what to collect, and how to analyse and model the data, goes in the reverse direction.[4] There-

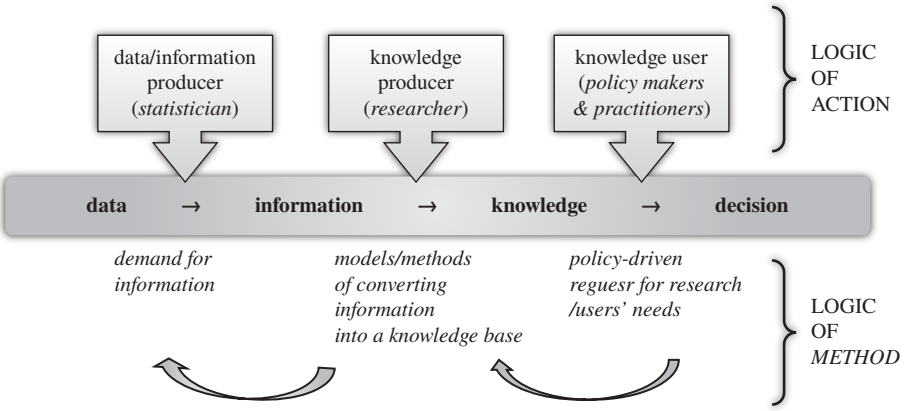
[2] The word "statistics" first appeared in the *The Elements of Erudition* (1787) by Baron v. Bielfeld (Federer 1991). However, Hermann Conring (1606–81), had earlier made a so-called statistical description of the country (*Staatenkunde*), not necessarily with the help of numbers, because the then German "university statistics" were essentially verbal rather than quantitative. This was in contrast to the quantitatively oriented version of statistics, or "English numbers," a contemporary practice led by William Petty (1623–76), see Lazarsfeld (1961), Alonso and Starr (1987), Federer (1991).

[3] A "Statistician … is anyone who contributes to the final delivery of (products) statistics and data to users"; the authors specifically mention "theoretical statistics—survey methodology—field specialist—technologist/IT specialist—representative research manager" (Platek and Särndal 2001: 3).

[4] The view that modelling is a prerequisite of data collection concurs with the working strategy of analytical sociology (e.g. Boudon 2001) and, more generally, with the orientation called methodological individualism,

Figure 1

The statistical process as an object of dual co-construction: socio-pragmatic (according to the logic of action) and cognitive (according to the logic of method)



Source: Okrasa (2017).

fore, it seems reasonable to distinguish between the two dimensions of activity—the logic of action and the logic of method—while exploring key elements of the statistics-society relationship. Since the goal of the proposed meta-model is strictly heuristic—to display the complexity of the system (process) in terms of the tools and participants involved in a specific inter-stage transition or stage of product creation—it can provide a framework for modelling the interplay among them.

The aforementioned holistic view of the statistical process is produced here mainly by a focus on quantification and communication, as well as their social conditions, which are not included in typical considerations of statistical research. The holistic view begins with the choice of language, which is the subject of the semiotics of statistics, and with a sociological analysis of the meanings of basic terms such as the unit of observation and analysis and so forth, and of the methods and forms of description of the objects and phenomena to be examined. This is the meaning of quantification, that is, determining the ways in which phenomena such as, for example, unemployment, inflation, or poverty are measured by official statistics. The process involves all the participants (the stakeholders): the statisticians, the data providers, recipients, and users, and collaborators and evaluators (formal and informal), including academic circles and the media.

The Sociologization of Statistics

Within such a multi-dimensional approach, sociologization emerges as an appropriate strategy for analyzing the statistics-society relationship, and the statistical process as a primary

or "structural individualism," as some authors propose to call the version presented in Coleman's (1990) conceptualization of the micro-macro transition "as the foremost theoretical problem for social science" (Marsden 2005: 12).

social process. Instruments for such an implementation of sociologization are provided by the sociology of statistics, which has developed so far primarily in relation to official statistics, as demonstrated by Desrosières (1998). Sociologization also means taking into account the historical context, which interacts with virtually every aspect of statistical processes. It includes what is sometimes referred to as the "Desrosières standard" (e.g., Barnes 2000),[5] that is, analysis of the interaction between scientific description, coding, categorizing, measuring, and analyzing on the one hand, and the administrative and political area of activity, such as decision making, intervention, and improvement, on the other hand (Desrosières 1998).

Another aspect of sociologization appears in the context of the traditional distinction between "theory" and "research" (meant as an empirical part of scientific activity). Sociologization might be viewed as a way of contributing to the integration of "theory" and "research." Some sociologists—notably Goldthorpe (2000, 2007)—consider the lack of such integration to be a long-standing "scandal of sociology." Such integration is normally expected within a post-positivist or Hempelian paradigm of inference, where the explanatory power of "theory" is apparent in the presence of "data." Both theory and data constitute components of a common framework and substantiate each other. However, Goldthorpe alerts readers that a tendency to obscure empirical evidence in certain schools of "theoretization," which has appeared recently in the literature, raises the threat of the "separate development" of these two counterparts of science.[6]

A supposition still being advanced in the literature—that statistical technique alone is capable of providing sociological explanations, especially in terms of causation—might be found invalid when perceived in the statistics–society (sociologization) perspective. On the contrary, as statisticians have emphasized (Holland 1986), there is "no causation without manipulation," or without the empirical interpretation of the variables involved, as complemented by econometricians (e.g., Heckman 2006). Therefore, a model of controlled experiment should guide research activities in sociology as well, as advised by Stouffer (1950), and propagated also by Nowak (1976), regardless of their survey-based or case-study character (for more, see Morgan and Winship 2007). The "theory could no longer claim autonomy from the findings of empirical research but would be called upon to demonstrate its explanatory power" (Goldthorpe 2007: 190).

Having delineated the conceptual scope of sociologization, its constitutive elements may be summarized in terms of four major areas of reflection: *theoretical premises*, *accountability*, *responsibility*, and *reactivity*. In fact, their operationalization requires a reference to the institutional context, that is, to the statistical system within which the research process is being conducted by public statistics offices.

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[5] Barnes points out that "rather than assuming that statistics are inherently correct because they are based on seemingly universal laws of logic and mathematics, [Desrosières 1998] shows that statistics are a conditional and local undertaking, depending on the peculiarities of the specific social, cultural and political contexts in which it is practiced" (Barnes 2000).

[6] Two examples of such a threat can be found in Alexander's and Giddens's works. Alexander (1998) assumes that data are on one extreme of the "scientific continuum," from "abstract and metaphysical" to "empirical and factual," while Giddens (1984) maintains that theory merely serves the empirical work (see Goldthorpe 2000: 3–4).

The theoretical premises for the conceptualization of the society—statistics relationship can be found in sociological interpretations of the modern models of the state and society. Such a model was first provided by Max Weber, who described the rationalization of public activities through the anonymization and standardization of public sector management, which takes place as a result of the development of bureaucracy, the growing importance of technology, and the role of technicians and engineers. Together, these factors are interpreted as the effect of economic, technological, and social sciences development, which also includes statistical research.

This approach generally accords with the neo-Foucaultian approach, which recognizes state-building capabilities as the main property of (official) statistics, enabling governance (governmentality). According to Michel Foucault (2005 [1966]), modern statehood emerged in the eighteenth and nineteenth centuries thanks *inter alia* to such state-building features connected with statistics as responsibility, transparency, and usefulness in management ("manageability"). This is the case particularly in the liberal type of state, which seeks accordance with the "nature of things" (Desrosières 1998).

Accountability and the representation of divergent interests are considered in the political science literature to be one of statistics' particularly important contributions to "democracy" (Prewitt 1987). National, official statistical systems are irreplaceable in this function despite their limitations. For statistics to fulfil this function properly there must be relevant and useful statistical indicators, purposeful and objective measurements, and the comparability of numbers in time and space.

Responsibility is also a key category in the conceptualization of society as a communication system according to Luhmann (2012 [1984]). Luhmann stresses the indispensability of using numbers in the system of power and governance, with special emphasis on the organizational structures securing responsible communication. The basis for responsible communication is provided by standardization and by trust in the methods, as evidenced by specific communication codes. By defining systems and subsystems, such as the economic, political, or legal system, these codes enable inter-system information transfers and communication, along with rules of interpretation. Two types of codes are required as far as statistics is concerned. The first should determine if something is (or is not) measurable. The second, when present, should suggest the need for a measuring scale. In this way, as Hovland (2011) notes, the numbers operate as boundary objects between organizational subsystems and are "Trojan horses" in social systems, which are treated as communication systems. Official statistics become Trojan horses in the social system because "rational" ("economic") management should be based on a statistical system, covering the processes of production, distribution, and use of statistical information.

The reactivity of statistics and the construction of comparable statistics, indicators, and accounts contribute not only to the rationalization of the state in the Weberian sense, but also to its creation (nation-building), as emphasized by Foucault. According to Espeland and Stevens (2008), this occurs through the ability of statistics to combine amorphous objects and features into a whole consistent with the ideas of politicians, government representatives, and civil communities. And, at the same time, statistics not only shed light on phenomena such as "public opinion" or "unemployment," but also co-create them by the way they present them.

The Historization of Statistics

Some historical events related to the use of statistics provide spectacular examples of statistics playing such a state-creative role. The first concerns the construction of the equivalence scale used in the first US census in 1790—the first census in the world. It was proposed by Hamilton and Madison for the proportional distribution of seats in Congress and the budget between states (Anderson 1988). This equivalence scale treated five slaves as equal to three free citizens. The three-fifths ratio persisted, despite being disputed, from the eighteenth century until the census in 1870 (Anderson 1988).

Emphasizing the need for the historization of statistics, Desrosières (2011) cites studies on the state-building role that statistics played in the unification of Italy in 1820–70. Statistical data somehow led to the emergence of the "Italian nation" as a cognitive space, including in this category the inhabitants of independent principalities, who had been under the rule of various external powers for centuries, without even a sense of national identity and community (which was only awakened by the Garibaldi uprisings). Another example is the statistical classifications that created "statistical communities" by distinguishing categories such as "staff" (*cadre*) in France in the 1930s for insurance purposes. According to Desrosières, being included in the same social category contributed to increased solidarity between traditionally feuding groups of employees (such as those employed in engineering and managerial positions). In this context, Alfred Kinsey's research on sexual behavior provides another example: research demonstrating that homosexuals constitute a numerically significant group in the population gave them visibility as a significant statistical community.

Historization, as a twin perspective of sociologization, also has important methodological consequences for studies undertaken explicitly from the standpoint of the sociology of statistics. Carter and Sutch's (1995) study, which reviewed occupational data from the 1880 US federal census, focused on differences between the numbers of workers "enumerated" and "published." The analysis revealed significant differences in the employment status of certain categories in regard to the figures reported by enumerators and the figures that were published ("after editing"). The differences particularly concerned "working women" and the incidence of "child labor." Carter and Sutch's insight into the social construction of official statistics of that era has revealed that the published figures were "covertly alerted" and "the American statisticians have taken less of a positivist approach to their work than previously thought" (p. 29). From this example it can be concluded that the historical sociology of official statistics may perform data control and quality-improving functions due to a variety of interests connected with the public statistical services.

Statistics as a technology of government and governance. The perception of statistics as a technology has become standard in public sphere management (e.g., Saetnam et al. 2011). Statistics are thus perceived to constitute a major tool for modern governance and management, which should be based on knowledge derived from data and embodied primarily in indicators constructed for the purposes of planning, the development of economic and social processes, and the evaluation of programs. The most spectacular expression of the role of statistics as a management technology is the contemporary

approach called "management through indicators" or "governance by indicators," which is recommended by international agencies. The management strategy through indicators includes approaches that were earlier called evidence-based or knowledge-based management.

According to such experts as Saetnam et al. (2011), modern statistics owes its special role as a management technology to its three constituting components:

(a) a better recognition of the dependence of the statistical description of reality on social factors—the above-mentioned historization and sociologization of statistics—thanks to which Desrosières considered statistics to be a "regime of truth";
(b) formalization of the language (mathematics) allowing the establishment of standards of objectivity and impartiality, along with the recognition that objectivity is part of the process of cognition, and not a "natural" affair (Porter 1995)—that is, statistics as technology;
(c) the generally established belief (after Adolf Quetelet) that probability is a better way to describe regularity than "determinism" (which is not very useful for describing social phenomena)—that is, statistics as an information base for governing.[7]

To summarize, two aspects of the social immersion of statistics can be emphasized. First of all, there are interdependencies between statistical products and, in general, social reality. These products are partly dependent—in their form, informational content, and statistical knowledge—on the users, who always have explicitly articulated expectations, needs, preferences, interests, and standards. All these affect the construction of indicators and the form of communication. For instance, Nowak's (1977: 133–134) classification of indicators in social research—empirical, definitional, and inferential—provides a good example of the user's choices in combining the meaning, the construction, and the goal, while taking into account as well the distinction between the observational and latent character of the indicator and *indicatum* respectively in determining the relationship between them. In the vein of a similar interpretation, a dual framework for measuring subjective well-being is proposed in the literature by Maggino (2009), who distinguishes between complementary approaches: those that are "formative" (when observational indicators create a composed measure of well-being) and those that are "reflective" (when observational indicators are seen as a function of the latent construct).

The other aspect of sociological reflection that treats the statistical process as a social process is what determines the social position, or status, of statistics. Its position is the result of objective factors such as the quality and adequacy of statistical tools and products, and the subjective perception and image of statistics, including of the institutions that implement the statistical process.

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[7] Globally applied management through indicators use *inter alia* particularly important types of indicators that are produced by (or under the aegis of) international organizations (the UN, World Bank, OECD, Eurostat, UNDP, WHO, Unicef, etc.). Examples are the Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Human Development Index (HDI), Doing Business Indicators (IFC-WB), Corruption Perceptions Index (CPI), Governance Indicators (WB), Program of International Student Assessment (PISA), etc. Construction and application of the Balanced Development Index (BDI) is another good example of that kind of work in Poland (Koźmiński et al. 2020).

Quantification as a Social Process

Socio-methodological Dimensions of Quantification

Quantification is the most sociologically saturated part of statistical research. Therefore, the sociology of quantification emerges as the most significant part of the sociology of statistics. Studies of quantification have vastly expanded over the past few decades, going recently beyond the national scope, toward transnational governance.[8] The status of these studies has been changing as some authors have been asking whether they constitute a field of investigation in their own right (Berman & Hirschman 2018). A comprehensive account of the achievements of these studies so far has resulted in two suggestions for their future (Mennicken and Espeland 2019).

The first is the dimensionalization of quantification as a research problem through specifying the major questions: (i) what problem or uncertainty is quantification supposed to address?, (ii) how does quantification affect power and politics?, and (iii) how does it shape relations of visibility—what is noticed and what is not? (p. 228).

The second is the distinction between four institutional locations of quantification—administrative, political (democratic rule), economic, and personal.

— *Quantification and administration*. This can be seen in the public numbers related to production, taxation, and conscription in Antiquity; in seventeenth-century "political arithmetic" (William Petty 1623–1687), that is, the use of quantitative knowledge for state-governing purposes; in German cameralism in the eighteenth and nineteenth centuries; and finally in the contemporary administrative and political demand for census data (Mennicken and Espeland 2019: 228–9).

— *Quantification and democratic rule*. Quantification has been an important means for the organization of political activism, social movements, and protests. The statistics on social and economic inequality, for example, are critical to drawing attention to issues of social stratification, inclusion, exclusion, class structure, and social mobility. For example, statistics on inequality have made visible the negative consequences of neoliberalism, with regard to rising precarity (pp. 231–232).

— *Quantification and economy*. Quantification and commensuration affect economic calculation and action. Thanks to quantification, the performances of various agents are visible, trackable, and capable of being compared. While concurring with principles of efficiency and rationality, they are crucial for market and capital investment (pp. 233–234).

— *Quantification in personal life*. Self-tracking involves a kind of recording and measuring in which people knowingly and purposefully collect information about themselves. The *datafication* of everyday life offers new possibilities for quantification and produces novel forms of commensuration, classification, and stratification (pp. 236–237). The above interpretation of quantification clearly exhibits its multifaceted character, which

[8] Mennicken and Espeland (2019) quote Luc Boltansky's (2015) observation that an increased interest in quantification is accompanied by a crisis of faith in quantification, intensified by the global financial crisis of the late 2000s and subsequent debates about financialization, economization, and neo-liberalism (p. 224).

consists in the comparison of different entities according to a defined metric (Espeland & Stevens 2008).

Convention and Measurement

Quantification implies measurement but differs fundamentally from it. It initiates the statistical process and remains at its core practically to the end of the study, being also present in the construction of analytical variables and indicators. Quantification thus represents the complex system of generating and processing data into numerical form. Therefore, quantification is something broader than the measurement itself. According to Alain Desrosières (2016: 184) "quantification entails, firstly, agreement, that is deciding on the conventions, choice of objects and modes of equivalence." Once such conventions have been established, the measurement process is initiated. What distinguishes quantification from measurement is primarily the fact that it incorporates the convention on which the measurement is based. We can quantify everything, noted Desrosières (2006)—even something like love or happiness or a particular product—as long as we know *what* it is, that is, *how* to measure it. This clearly resembles the postulates of early operationalism (Bridgman's version).

Measurement is essentially a counting process that includes an important practical question about *what* is counted and *why* it is or is not counted. (This recalls the observation ascribed to Einstein that "not everything that counts is counted, and not everything that is counted counts.") The fact that decisions about official statistics are taken arbitrarily by the relevant institutions makes them prone to deformations. For instance, the disparities in crime statistics between the understated (or inflated) data of "police statistics" (where there may be an interest in demonstrating the efficiency of law enforcement services) and those of "civil society" (which are generally higher) are most often cited in this respect.

The numbers occurring in the quantification processes are distinguished by the type of information transferred. These are the numbers that mark (identify) the objects, and those that measure and compare the values of specific characteristics of the objects. According to the classic typology of scales (Stevens 1946), the first occur in "qualitative" data (nominal and ordinal scales); the second in "quantitative" data (interval and ratio scales). The above clarifications are important due to the fact that numbers, as well as charts and formulas, are chosen according to a particular communication strategy (Porter 1995) and as such are socially constructed (Schield 2013). As Saetnam et al. (2011) notes, the act of counting inhabitants, territories, resources, problems, and so forth, is one of the acts by which the state participates in creating both itself and its citizens, as well as the policies, rights, expectations, and services that connect them (p. 21).

Quantification as a Sociological Phenomenon

Considering quantification as a sociological phenomenon (Espeland and Stevens 2008; Alonso and Starr 1987; Federer 1991; Desrosières 2006) involves the production of information and communication by numbers—according to the above-mentioned CSID sequence (Duncan et al. 2011)—with classification as a prerequisite for measuring. This includes the choice of the principle (the convention) of division (distinction) of classified

objects, which is always a social endeavour *per se*. Unlike convention, measurement is not a matter of establishing something (even in constructionism, within which arithmetic is treated as being "set"). However, it is one of the communication systems that can be selected (in Luhmann's sense (2012 [1984])), for responsible communication in society. Indicators play a special role in such systems as "crucial epistemic devices in the *politics of expectations* that facilitate formal and calculable conceptions of uncertain futures" (Bartl et al. 2019: 13), and their relevance in *factual*, *social*, and *temporal* dimensions (following Luhmann's distinction) needs to be recognized when analyzing particular aspects of the "politics of expectations."

Of the many possible ways of communicating, quantification—thanks to the use of the rigorous and universal language of mathematics—is best suited for supra-local, supra-specific and supra-disciplinary messages of information and knowledge. The advantage of quantification is that it abstracts from the idiosyncratic elements of the individual perspective. However, there is a risk that the apparent rigor and objectivity of the statistical description may be achieved at the cost of losing the insight and accuracy of a verbal, qualitative description (e.g., Cool 2000; Collins 1984).

According to the socio-historical perspective of the science of science (Desrosières, Porter and others), quantification gave rise to both statistics (e.g., Quetelet's "average man") and sociology (e.g., A. Comte followed by E. Durkheim's empirical studies) in the nineteenth century. Since then, statistics and sociology have mutually supported each other, especially in respect of their methodological advancement but also in their interpretation of empirical findings. This reciprocal support became particularly intense after the eruption of sociological survey research in the 1940s (Clogg 1992; Raftery 2001; Okrasa 2012). Modern empirical sociological cognition is accomplished through the process of quantification, including the conceptual distinction of such concepts as "man," "group," "society," "values," or "behavior." Their numerical and symbolic expression takes place even within narrative or interpretative sociology. In his comments on the sociological cognition, Pierre Bourdieu (1990) distinguished two paradigms of such cognition: epistemic and sociotechnical or functional. The second of these is the subject of the "sociology of sociology," or "meta-sociology." As emphasized by Porter (1995) in discussing these distinctions, quantification must take into account not only (and not so much) the epistemological and historical dimension, but—above all—sociological aspects, including identifying its role in actual social, cultural, and political contexts. Meaning, classifications, and values are culturally and socially mediated.

Espeland and Stevens (2008) proposed five dimensions or areas of interest that should be included in a consistent conceptual-methodological model for integrating quantification problems common to various social disciplines:

(a) *reactivity*, understood as the desire to adequately reflect what is measured and to make the numbers credible;
(b) *steady interest* in conducting systematic quantification analyses;
(c) *cognitive and ethical rigor*—control over the possibility of influencing social behavior through numbers and safeguarding against the use of measurements with originally descriptive purposes for purposes of assessing and controlling behavior ("number ethics");

(d) *the authority of the methodology* and the explication of ways to use quantitative data depending on the attitude in relation to the measurement/number-reality relationship (e.g., Desrosières's typology, below);
(e) *aesthetics and attractiveness* in the clear presentation of reliable results of measurements and analyses.

As a kind of generalization of the above elements, it might be useful to recall the concept of the attitudes of the process's participants, as originally proposed by Desrosières (2001).

Attitudes Towards Quantification

Desrosières (2001) distinguished four types of attitudes toward quantification in official statistics. Based on the observation that statistics "reflect reality" or "approximate reality as accurately as possible" he not only emphasized that statistics (numbers) and reality are separate, he assumed that statistics reflect implicit attitudes to reality and to the number-reality relationship as well:

(i) *metrological realism*, emphasizing measurement and statistical inference based on "statistical observation" (such as a survey)—an attitude transferred to the social sciences from the exact sciences (mainly, astronomy) in connection with the representative method;
(ii) *accounting pragmatism*, as exemplified by national accounts, with "objectivity" in monetary expressions of value, regardless of other influences (making up "mechanical objectivity," according to Porter 1995);
(iii) *argumentation and quantification*—an attitude promoting the use of databases, the systematic quantification of economic and social phenomena, as well as emphasizing the importance of "quality" in the sense of seeking to identify errors;
(iv) *conventional and constructivist* (nominalist) recognition of variables, their definitions and codes (occurring particularly in situations of change and innovation)—including the problem of harmonizing categories over time as required by Eurostat, or difficulties in determining the "statistical unit" (consistent in the longer term range), especially in business statistics ("negotiated" and conventional).

Attitudes (i–iii) are reinforced by assumptions of "objectivity," understood as the independence of what is measured from the act of measurement itself and vice versa. Such objectivity is sometimes called "mechanical objectivity," since it concerns quantification in accord with methodological standards of acquisition, processing, and the use of statistical information (Porter 1995). When these standards are observed, the reliability of the data is independent of the participants of the statistical process. Thus, the trust in people—experts, authorities, influential elites, and so forth—is associated with trust in numbers. On the other hand, reports on attitudes toward certain aspects of reality in public opinion research might be biased as well: first of all, because of differences in the indicators used and in possible ways they can be presented (Espeland and Stevens 2008) and also due to the differences in their perception and understanding, dependent on the so-called "economic imagination" of the public (Zagórski 2018).

Social constructivism involves the problem of the status of epistemic practices. According to Espeland and Stevens (2008), it is parallel to the hierarchy of authority in an insti-

tution (organization) and is accompanied by the "uncertainty absorption" effect in March and Simon's (1958) sense: "raw" information at the entrance ("at the bottom" of the institution) is processed toward a condensed extract that appears—after rejecting "imponderabilia" at the exit/"near" the top—more reliable than raw data would allow, because conclusions rather than data are the subject of external communication (Espeland and Stevens 2008: 422). Another problem is "statisticism," which as Otis Duncan (1984) described this term, is a tendency to misuse statistics as an end in itself.

Statistical and social processes should be jointly analyzed after specifying the main components of the quantification process—convention (including standardization), as well as measurement (including modelling) and communication (including information formatting and indication). This would create a new perspective and give the basis for an appropriate, holistic analysis of the dynamics of the statistical system.

The Image and Status of Statistics—Elements of the Sociology of Statistics

Elements of the Sociology of (Institutional) Statistics—the Preliminaries

The remarks made so far on the sociologization of statistics, covering virtually all aspects of statistics as a social process of generating, analyzing, distributing, and using data, show its principal position within sociology and special contribution to sociological analysis. Moreover, sociologization, as an approach essentially without a formally codified methodology, offers a broader perspective than the traditional sociology of statistics. It embraces new institutional aspects of statistics while remaining "paradigmatically" open on elements which are not necessarily a part of the statistical system in its strictly formal sense.

Such a characterization of the modern sociology of statistics may appear somewhat instrumental. This stems from the empirical context of reflection adopted here—reflection on the status of statistics in society, which includes its image. However, in referring primarily to the institutions of public statistics, such an approach contrasts with those focused on other domains of interest, such as on the experts or on the scientific status of the discipline.

The classical paradigm of statistics in sociology includes, after P. Starr (Alonso and Starr 1987: 8), five main areas of sociological interest in the statistical system. However, the most important is the distinction between interest in two types of structures and organizations adopted by statistical institutions:

(i) *social structures*, consisting of the social and economic relations of citizens (e.g., potential respondents), state agencies and private companies, as well as professional groups, international organizations, and others involved in data flow processes, from their sources to centres of analysis, distribution, and use;

(ii) *cognitive structures,* including information formatting, research principles, reality assumptions, classification systems, measurement methods, as well as official procedures and rules for the interpretation and presentation of data.

Other elements of this paradigm consist of:

(iii) the origin and development of the statistical system;

(iv) the role of the statistical system and the effects of its use, that is, how the form of sharing statistical information affects decision making, society, and the functioning of the state;
(v) ongoing systemic changes.

The description of specific official statistics systems in terms of the above dimensions of sociological analysis allows the mutual influences of sociology and statistics to be identified during their development. The relations of statistics with psychology (especially psychometrics), economics (especially econometrics, as the most "statistically" advanced discipline of social sciences), and biometrics—which are sometimes referred to as the "three metrics"—developed somewhat earlier.

Relations between sociology and statistics have not always been seen as symmetrical. Many outstanding statisticians shared Sir Ronald Fisher's view that it was only the increasing use of statistics that gave the social sciences (economics included) the rank of science (Clogg 1992: 183). On the other hand, the reverse impact of the social sciences on statistics, which is especially visible in the case of sociology, for example, in regard to sampling methods or analyzing qualitative data and "hidden" variables—was less recognizable, though undeniable (Lazarsfeld 1961; Duncan 1984; Clogg 1992; Raftery 2001; Okrasa 2012).

Arguments and examples demonstrating the significant impact of sociology on statistics, particularly on the methodology of statistical research, are apparent primarily in such concepts and methods as surveys, attention to non-random (systematic) errors, hidden structures and latent variables, log-linear models, path analysis, event history analysis, or causal inference (including "observational"—as opposed to "experimental"—data, such as survey experiments, Mutz 2011; Okrasa 2014). According to such experts as Clogg (1992), and Raftery (2001), this sufficiently counters Fisher's underestimation of the methodological status of the social sciences, including sociology.

Another stream of critical literature refers to the role of statistics generally in the social sciences, with particular emphasis on the apparent deficiencies of statistics as a key method of empirical sociology. One of the most spectacular objections—which is worth mentioning here—was Randall Collins's (1984) anti-positivist act of condemning so-called statistical sociology (the term used interchangeably with mathematical sociology). Collins's vision of statistical sociology, which was shaped in the Fisherian spirit and thus aspired to set scientific standards thanks to its alleged neutrality and objectivity, reflects his idea of the role of statistics as being limited to model-based theorizing in the sphere of macro-phenomena, while abandoning the verification of causal relationships in micro-sociological areas: "the greatest value of statistics is as a theory rather than as a method" (Collins: 335). Such a position is not inconsistent with views on the methodology of statistics (e.g., Holland 1986) and econometrics (e.g., Heckman 2006) that emphasize the predominant role of experimentation in testing causality, especially given that it accords with the postulate of "turning statistics into substance" in the search for the causal mechanisms behind statistical distributions (Collins: 350). Moreover, this position coincides with the assumptions and goals of analytical sociology (Hedström and Bearman 2009), where, however, the macro- and micro-levels of reasoning are considered inseparable (within the framework depicted by "Coleman-Boudon's boat"). It is thus proven that statistics needs to play a much broader role in empirical sociology, including in macro-structural and micro-sociological areas, than was envisioned by the proponents (such as Collins) of the earlier distinction between

quantitative ("mathematical") and qualitative ("anti-mathematical") methods of research,. However, in an era when research is overwhelmed by mixed-methods methodology, which combines survey or experimental studies with, for instance, ethnomethodology or ground theory in realization of a common research strategy (e.g., Creswell 2015; Ametowobla et al. 2015), such distinctions and debates seem to be totally unsubstantiated and obsolete. And the public esteem enjoyed by statistics is largely derived from its usefulness and firm presence in empirical studies conducted within empirical disciplines, thus confirming Neyman's statement that "statistics is the servant of all science," while contributing at the same time to the interdisciplinarization and methodological integration of scientific research (Okrasa 2012).

Quality as an Object of the Sociology of Statistics

The recognition that quality is of great importance for the image of statistics has several consequences. First, the sociology of statistics is particularly well-positioned to identify the sources of possible deviations from quality standards at virtually every stage of the statistical process. Treating the statistical process as a social process is usually associated in the literature with the reduction of non-random measurement errors, primarily in survey research. This is a part of the approach to quality promoted by Deming through Total Quality Management (TQM). The importance of reducing the total error of sample-survey results is an effect of amalgamating the TQM approach with advancements in psychometric methods ensuring reliability and accuracy of measurement (e.g., Groves 1989). Technically, total error includes "Mean Squared Error," which is the main criterion for assessing the quality of statistical estimates:

$$\text{Mean Squared Error} = \text{Variance} + \text{Squared Bias}$$

Admittedly, there is a common belief among experts—confirmed by methodological research—that the reduction of errors in statistical surveys is a multidisciplinary undertaking. The special role of the sociology of statistics in regard to sample surveys and more general processes of generating "observational data" has been emphasized. First of all, this role is related to the tools, the respondent, and the interviewer. The sociology of statistics is concerned with such problems as (Biemer et al. 2004) (i) the design of research tools (questionnaires, etc.) that take into account the impact of how questions are formulated, their order and arrangement (the "context effect"), (ii) how data is collected, (iii) the ways and conditions of conducting interviews (as an interaction process), and (iv) evaluation of the work of interviewers and other field personnel.

Having all these in mind, the demand for a sociology of the statistical image emerges as a new means of studying the conditions and effects of research projects. In fact, the sociology of each of the main types of activities of the institutions responsible for the statistical image could be discussed: the sociology of statistical data production, data processing and analyzing, and of sharing and using statistical information in administration, the economy, and society. Of particular relevance in this context is the sociology of cooperation with

external stakeholders. Such a sociology would be helpful for considering the use of alternative, non-statistical sources, such as administrative data or big data.[9]

Ethics, *defining the principles of ethical conduct*, serve to safeguard the general values in official statistics. Therefore, ethics should not be considered solely as an autotelic object, as implied by Popper and his followers. It is also functional for the image and social status of statistics. As emphasized by William Selzer (long-time chairman of the American Statistical Association's Professional Ethics Committee, ASA), institutional responsibility cannot be a veil for individual responsibility: "[In] any case, neither the state nor the scientific nature of official statistics exempts the staff of statistical offices or their managers from individual and corporate moral responsibility" (Seltzer 2005: 1).

Indicators constitute the final product of the quantification, or more clearly, of a conventions-based measurement process, which is intended to be a process of assigning numerals to units of analysis using a consistent set of rules. Indicators embody rational premises and the achievements of statistical (methodological) and non-statistical influences, such as social, economic, political, and cultural ones.

At present, indicators are particularly important objects in the sociological analysis of relations between statistics and society due to their vital role in management and governing. Given the growing importance of indicators for governance, and the level of advanced knowledge involved in their construction, they all deserve systematic consideration from several (sociologically relevant) standpoints in order to resolve various conceptual, methodological, and practical problems. Among other indicators, the following can be mentioned: Gross Domestic Product/GDP (which has become more complicated after the "Stiglitz Report" postulated going "beyond GDP," e.g., Giovannini and Rondinella 2018); the Consumer Price Index/CPI; GINI and other income inequality indices (Cowell 2008); Sustainable Human Development/SHD (Anand and Sen 1994), the construction and interpretation of which remains under debate (e.g., Ravallion 2012); multidimensional poverty indicators (Alkire and Foster 2011; Cimadamore et al. 2016; Okrasa 2018) and unemployment rates (Innes 1990); well-being and quality of life (Maggino 2017; Diener et al. 2018; Okrasa and Rozkrut 2019); social mobility and social structure (Domanski 2004); Sustainable Development Goals/SDGs (UNRISD 2017); the EU indicators for social inclusion (Atkinson et al. 2002); and innovation indicators (Ametowobla et al. 2015).

Of special relevance in this respect is the sociologically recognized impact of not-always-overt non-statistical elements on the construction of indicators. Non-statistical social influences may deliberately or unknowingly create a bias. This creates concern about the proper understanding, interpretation, and use of indicators. For instance, the understanding and use of price indices in policies about the revalorization of pensions or determining the social-minimum threshold for poverty-reducing programs provide good illustrations. Speaking more generally, sociological analysis is supposed to encompass the above-men-

[9] Big data, that is, a rapidly growing new generation of mass data (usually in digital form) is in fact a by-product of the operations of many various institutions, such as banks, insurance and other service agencies (including agencies that provide electronic transactions and internet communication), social forums, laboratories, publishers, and so forth. Issues of privacy and of securing the confidentiality of individual data, as well as the legal aspects of data ownership, have given rise to a new type of challenge for the institution of official statistics (e.g., Okrasa 1994).

tioned process of management through indicators by postulating a more effective form for the use of statistics in decision making and program evaluation.

Summary and Conclusions

Conceptual-methodological considerations focusing on social determinants and covariates of the statistical research process—both its external conditions and constitutive elements—compel us to reach for the sociology of statistics as the basic investigative framework. The sociological framework allows the statistical research process to be seen as a social process, involving relations between statistics and society. Systematic exploration of these relationships should involve two parallel logics: the logic of method and the logic of action. These two logics make it possible to supply relevant final products, from data to practice-supporting statistical knowledge, which—in turn—facilitate evidence-based decision making, knowledge-informed policy, and so forth.

Sociological exposition of the conditionals of the statistical research process—with emphasis on its *differentia specifica*, namely quantification—goes beyond the scientific (cognitive and methodological) elements to encompass political (democracy), economic (efficiency), organizational (administrative), and even individual (personal self-tracking) aspects and points of interest.

The imposition of an institutional form on an otherwise somewhat abstract-seeming "statistical research process" by referring the relevant activities and performance norms to the standards expected from official statistics, makes the items discussed and the argumentations operationally identifiable and achievable. Then, the major analytical instruments offered within the two concomitant perspectives in the sociology of statistics—that is, sociologization and historization, along with such imperatives as theoretical premises, accountability, responsibility, and reactivity—allow for the materialization of the aims that national statistical offices are obliged to achieve.

Furthermore, such an institutional "contextualization" extends the concept of the implementation of the statistical process by the concept of the functioning of the statistical system as a more exhaustively interpreted subject of the sociology of statistics (with a useful distinction between social and cognitive structures). Then, the status and image of statistics is affected by its quality, which is the ultimate goal of all the efforts both within the statistical process and external to it (including other disciplines, e.g., psychology, econometrics, history, political sciences).

This opens a new chapter for research, whose findings would facilitate the improvement of statistics and the effectiveness of its use, along with improving its image. Taking into account the social, cultural, and political context of the quantification process, such studies would lead to the interdisciplinary and transdisciplinary integration of empirical research and to strengthening the "ethics of numbers," and thus the position of statistics in society.

As a part of this perspective, there is another question that is important from an academic point of view, namely, the question regarding the social challenges of statistical education. As a consequence of the recognition that "all statistics are socially constructed" (Best 2001—see Schield 2013), the question arises of whether it would not be appropriate

to introduce a "basics of statistics" curriculum for students and other users (including the media), which would cover elements of the "social construction of statistics." This would meet the expectations of many sociologists, such as, for instance John MacInnes (2011), who warns that the mathematics competencies taught in schools are focused on mathematical techniques at the expense of either their application or "any sense of the relevance and power of numbers."

Finally, the practical significance of statistics in society is worth mentioning. This is closely related to the status of statisticians, both as professionals (Okrasa and Witek 2013) and as labor market participants. Systematic observation of this aspect of statistics has been conducted by the Bureau of Labor Statistics (BLS) in the USA. Since 2000, the employment of statisticians has increased in the USA by 54 percent (from 17,520 to 26,970 people). Statisticians belong to the group of ten professions that have seen the largest increase in demand in the American labor market. Therefore, the tertiary education system needs to be extended to meet the growing demand for statisticians and data analysts. Sociology should expand the attractive area of investigation into the increasingly complex issue of statistics in society: its relation to the economy and the state, its social role and significance for research and decision making. There should thus be an incentive to consolidate and further develop a relatively new but highly needed scholarly discipline: the sociology of statistics.

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