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The geography of statistics: Social statistics from moral science to big data

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Abstract
Statistics are central to the state's capacities. However, with the advent of 'big data' some argue it is being undermined in favour of a new configuration of corporate power. We need to understand statistics both historically and geographically to understand how it is intertwined with the geography of power today. Three strands to the geography of statistics are proposed: the geography of statistical institutions and agencies; the geography of 'datafication'; and the geographies produced by statistics. Tracing the geography of statistics demonstrates its role in the construction of a hierarchical world and explains the consequences of changes in statistical practice.

Keywords
big data, economic statistics, gross domestic product, history of statistics, social life of methods, social statistics, topology

I Introduction

The last decade has seen the publication of several popular and scholarly histories of Gross Domestic Product (GDP) (Coyle, 2014; Lepenies, 2016; Masood, 2016; Philipsen, 2015; Karabell, 2014; Fioramonti, 2013). Collectively, these works examine a key period in the history of statistical knowledge – the middle decades of the 20th century – and the events and circumstances surrounding the making of GDP alongside the array of other indicators, such as the Consumer Price Index and the Unemployment Rate, that have come to inform notions of societal progress. But these histories are really obituaries. They all agree that GDP is a measure in decline. Explanations are offered that echo earlier critiques (Waring, 1988). One is that GDP is reductive, offering seductive mathematical equations that fail to capture the complexity of the world (Masood, 2016; Lepenies, 2016). A more sociological argument is that as GDP growth became the defining task of government, so society ended up focusing on the wrong things, like increasing consumption while ignoring inequality, leading directly to present-day environmental and social crises (Philipsen, 2015; Fioramonti, 2013). An economic explanation for GDP's decline is that economies have changed so much since the middle of the 20th century – a period when it

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made more sense to imagine economic activity as contained in the territory of the nation-state than it does now (Coyle, 2014; Karabell, 2014). GDP is found socially, environmentally, morally, and economically wanting.

It is no coincidence that these histories were published in the 2010s. The financial crisis of 2008–9 shook not just the global economy to its core but the discipline of economics (Hodgson, 2009; Mirowski, 2010, 2013; Krugman, 2009). These authors have swooped on the empirical foundations of economic knowledge in their diagnoses. But this is not all. Several reference the rise of new kinds of datasets, from an increasing array of government data on more and more aspects of society, to the increasingly sophisticated private datasets of large corporations, to the massive data pools being created by new communications technologies – so-called 'big data'. Data is now collected by a wide variety of organisations in massive quantities through a range of avenues, including transaction records, social media, weather sensors, internet-enabled appliances, security cameras, and medical devices. Increases in computing power and storage make the analysis of this data possible, and new kinds of information and knowledge can supposedly be produced based on 'real world' data rather than just theories and hypotheses (Kitchin, 2014; Mayer-Schönberger and Cukier, 2014; Anderson, 2008).

It appears, then, that we are in a moment of transition. As the dominant modes of measuring human life from the second half of the 20th century fall out of favour, a new regime apparently rises (Davies, 2017; Wyly, 2014). This new regime is said to be housed as much, if not more, in the private sector as the public sector, and is more concerned with fine-grained data that can be mined for whatever it can tell us than summarised in a consistent fashion according to governmental requirements (Mayer-Schönberger and Cukier, 2014; Wilson, 2015). What to make of this transition? One possibility is to link it to shifts in the nature of the economic base: part of the superstructure of communicative (Dean, 2009), platform (Srnicek, 2017), or surveillance (Zuboff, 2019) capitalism. This kind of approach tends to emphasise newness and plays down or ignores the continuities between regimes and the question of whether seemingly new phenomena are really new (Ruppert et al., 2013; Savage, 2013).

A more historical perspective can help make sense of the changes we are living through. For one, as Barnes and Wilson (2014) point out, quantitative revolutions have occurred before. They have tended to have the same problem as the current 'big data' manifestation: their monist contention that everything can be explained in the same way, through numbers, makes important elements of what it means to be human drop out, such as the nature of human experience or its situation in power relations (see also Barnes, 2013, 2014). But more than this, the forms of knowledge big data does produce are grounded in epistemological debates that remain relevant about what counts as valid and useful knowledge (Rieder and Simon, 2016). Work in the Foucauldian tradition suggests that the success of statistical knowledge stems from its role in new arts of government. Statistical forms of knowledge do not so much describe populations and economies as render them visible, knowable, and governable as autonomous spheres with their own particular regularities and characteristics. Statistical knowledge serves to produce, shape, and discipline citizens and communities by rendering them calculable for various authorities (Miller and Rose, 2008; Rose, 1999; Beer, 2016b). Meanwhile, more and more parts of our lives – our work, health, social connections – are quantified in various personal technologies and analysed with statistical techniques with the effect of disciplining our behaviour (Nafus, 2016; Lupton, 2016). Michel Callon (1998; Callon et al., 2007; Callon and Muniesa, 2005) takes this further, arguing that this kind of statistical knowledge enrols us in networks of

devices and practices that constitute the calculative agency necessary to participate in the various markets that claim to deliver desired social outcomes. From this perspective, accounting for the history of statistics means accounting for the changing configurations of power and knowledge that statistical knowledge has been implicated in over time.

This paper proposes that this history of statistical knowledge needs a geography. Statistical reason and practice is not static. It emerged at particular times and in particular places, and has travelled almost everywhere since (Rottenburg and Merry, 2015). But it has not travelled easily. It must be constantly performed anew and often remade for new contexts (Barnes, 1998). The pressure of standardisation competes with the necessity of adapting statistical practice to new places: a struggle shaped by the particular political projects that drive its travel. Furthermore, the changing configurations of power and knowledge underpinning statistical knowledge will be material and spatial. Geographers make this point about big data, highlighting the socio-technical assemblages of material infrastructures of data collection, storage, and use, the uneven and variegated contexts in which this occurs, and the people and communities it includes, excludes, and shapes (Kitchin, 2014; Pickren, 2018; Graham and Shelton, 2013). Linking these assemblages to the statistical assemblages that preceded and shaped them is central to accounting for the changing configurations of power and statistical knowledge apparent today.

There is an historical literature that takes the enterprise of statistics as its object (Hacking, 1975, 1990; Porter, 1986, 1995; Poovey, 1998; Stigler, 1986, 1999). This work sketches out not just the history of statistical techniques and practices, but the way that statistical knowledge has been implicated in the changing configurations of power and knowledge that constitute the modern state. Geography is not absent from this work. Much of it has focused on the particularity of national statistical systems (Tooze, 2001; McDowall, 2008; Kalpagam, 2014; MacKenzie, 1981; Cullen, 1975), or compared them (Desrosières, 1998) because, as Ian Hacking (1990: 33) points out, 'every country was statistical in its own way'. This has meant a strong hint of methodological nationalism revealed in a tendency to treat differences in statistics over space in terms of relations of similarity/dissimilarity rather than more substantive relations of connection. Recently, there have been calls to consider the geographical components of these histories more systematically, producing a more 'connected history of statistics' (Beer, 2016a: 4). This paper takes up this challenge.

Of course, statistics have been analysed from a critical geographical angle, but not as a whole enterprise. Rather, geographical work tends to focus on the way that statistical knowledge has operated in particular contexts or as a feature of particular governmental regimes and projects (e.g. Marquardt, 2016; Jocoy, 2013; Hannah, 2000; Murdoch and Ward, 1997; Morrissey, 2013). The aim of this paper is to draw this work together to sketch out the contours of a broader 'geography of statistics' that is present across a variety of geographical and cognate work. This can complement and extend the history of statistics literature to show the geographical component of statistics' implication in the linkage between knowledge and power. It responds to calls to provide more history for our discussions of big data (Barnes, 2013; Barnes and Wilson, 2014; Rieder and Simon, 2016), although in a particular way. Rather than just demonstrate that we have been here before and many of the same critiques apply, or shine a light on the potentially problematic foundations of current big data claims (Longo, 2019a, 2019b), it asks how we can understand the role of statistics in constructing political order. It is clear that statistics are central to the emergence of the modern state, but as statistics transforms, then so must the state system be transforming as well.

After all, this may be what the reported decline of GDP represents (Davies, 2017).

The geography outlined in the remainder of the paper is of the statistical enterprise. This is the set of dynamic (or moribund) institutions, agencies, networks, texts, databases, and calculative devices that are populated by statistical experts and practitioners. I approach statistics not as a set of abstract claims, axioms, or methods – as a discipline in other words – but as a set of historical and material technical practices that allow a particular object – numbers – to circulate anywhere those practices reach. Even here, the term 'statistics' could signify a set of measurements, a form of scientific inquiry, a branch of mathematics, and theories of probability including Bayesian and frequentist. These different aspects are connected, not simply under the sign of statistics, but historically and materially. This paper cannot cover all of this, so uses social statistics, broadly defined to include economic and cultural statistics, as a starting point. The geography sketched out centres on the construction, maintenance and transformation of this pivotal part of the statistical enterprise. This focus shapes the argument, including its historical and geographical scope. A different starting point, one that focuses on theories of probability for example, would have a different scope.

By suggesting the history of statistics literature is geographically lacking, I do not mean that statistics ignores geography, or vice versa. This is clearly not the case. There is a rich tradition of geographical statistics, and geographers have made ample use of statistical knowledge to answer geographical questions. Indeed, statistics have been a defining part of the history of geography, such as during the quantitative revolution in the 1950s and 60s. There are many insightful histories written of the various pathways (Johnston and Sidaway, 2016; Billinge et al., 1984; Barnes, 1998, 2001a, 2004), and missed opportunities (Johnston and Jones, 2019), of this part of the discipline. This paper has a different focus. One, it focuses on statistics as an historic and ongoing enterprise that produces quantitative knowledge that categorises, orders and governs the social world. Geographical statistics are part of this enterprise, but not the whole of it. And two, it has a broader conception of geography, focusing not just on geographical knowledge produced with statistics, but on the various institutions, networks, spaces and places in which statistical knowledge is produced. In this sense it is similar to Barnes's (2001b, 2002) science studies-inspired histories of economic geography, but for the enterprise of statistics.

The next section briefly summarises key claims of the history of statistics literature referred to above. The remainder of the paper brings together geographical scholarship on statistics to suggest there are three avenues through which we can think about the geography of statistics. One is the geography of statistical institutions and the linkages between them across global space. Two is the geographies of data-making and collection, and how they are changing. And three is the geographies that this statistical knowledge produces. The paper concludes by arguing that these geographies should be considered together in order to reveal the topologies of space and time that statistics is implicated in, and to track their transformations.

II A brief history of statistics

Conventional histories of statistics trace its origins to the work of William Petty and John Graunt in the 17th century with their 'political arithmetick': the notion that one could govern with numbers (Lepenies, 2016; Cullen, 1975; Bayatrizi, 2009). But this approach was little used, and it was not until the 19th century that a transformation in statistics would occur alongside a requisite transformation in the configurations of power and knowledge that comprise the modern state. As the century began, statistics was a relatively peripheral and controversial

activity. By the early years of the 20th century, it was a well-established and respectable branch of mathematics, and increasingly important to other sciences and the work of the state (Woolf, 1989). Two trends underpinned this shift. One was a change in statistics itself from a form of description to a form of analysis as a result of its marriage with probability. The other was the decline of deterministic models of the universe. These trends were related, and would lead to significant shifts in the objectives, and objects, of government.

Both trends were partly the result of problems of knowledge that statistics itself inaugurated. Statistics means the knowledge of the state, and initially this meant description. Poovey (1998) makes the point that numbers today are often seen as fundamental facts about the world, while words are there to analyse and interpret these facts. But, she argues, this separation in the labour of word and number was not always the case. Numbers were another way of describing the world, not the thing to be described. By the first half of the 1800s, the separation of number and word had begun as numbers were increasingly seen as a particularly powerful way of describing the world. Leaning on an argument developed over a number of centuries that simple, sparse forms of language were best for describing the world, and buttressed by the prestige mathematics had attained, the simple language of numbers and mathematics presented as neutral (Poovey, 1998). This view led to what Hacking (1990: 2) calls 'an avalanche of printed numbers' during this period. Across Europe, states and newly-formed statistical societies began collecting and publishing numbers on matters of trade and the military, but also, importantly, on moral concerns (Cullen, 1975; Porter, 1986). These 'moral statistics' in aid of a new kind of moral science were records of supposed social pathologies – crime, suicide, and pauperism for example.

The sheer scale of numbers being produced became the basis for new ways of knowing the world, further prising word and number apart. The Belgian social statistician Adolphe Quetelet realised that the error curve that astronomers used to map out mistakes in celestial measurements applied to the human variation recorded in statistics. For Quetelet, this showed that there was some kind of underlying statistical reality that was apparent across all phenomena, from the natural to the social, embodied for the latter in the 'average man' (Desrosières, 1998). But Quetelet paid no attention to the variation itself. It was in the emerging science of eugenics in the late 19th century where the effort to understand variation led to probability being attached to social statistics, and statistics as we know it today emerged (Hacking, 1990; Desrosières, 1998; Porter, 1986; MacKenzie, 1981). New ideas and methods took shape, including regression analysis, significance testing and correlation (Barnes, 1998). Numbers were no longer just description, they were the basis for a new kind of social and scientific analysis.

These shifts were linked to the decline of the doctrine of determinism during the 19th century (Hacking, 1990; Porter, 1986). A deterministic universe has its laws and its fate laid down by providence. It was the job of the scientist to reveal how God's plan worked. Statistics would prove controversial because it clashed with this doctrine. Poovey (1998) argues that Malthus's turn of the century 'Essay on Population' was contentious because his use of numbers showed that humankind was destined to suffer. The logic of Malthus's argument was understood as a perverse and heretical claim that God's universe was a dark place and humanity was doomed. In this political context, for those reformers who saw something useful in numbers, such as those in the statistical societies (Cullen, 1975), it became necessary to present numbers as value-free, unconnected to any theories about how the universe worked, and so just descriptions of the world as it is. The Statistical

Society of London, for example, had an image of wheat as its symbol with the motto *aliis exterendum*, meaning that what it produced was 'for others to thresh out' (Porter, 1986).

With the subsequent avalanche of numbers, this problem became greater. It was apparent that particular phenomena in a society remained constant from year to year, including supposedly immoral behaviours like theft and suicide. This was what Poisson called the law of large numbers (Desrosières, 1998) and it was a problem for determinism. It suggested that people's behaviour was not the result of a moral failing, but some kind of deterministic law (Hacking, 1990; Porter, 1986). If such a law exists, as these observations suggest, what hope could there be for moral education and learning? What point to societal reform? But by the end of the century, these concerns had dissipated. The separation of word and number meant a reconfiguration of power and knowledge was under way, eroding determinism, which in turn helped to bed-in the idea that statistics were raw facts (Porter, 1986; Hacking, 1990). As forms of statistical analysis were developed in the later decades of the century, there emerged the possibility that a probabilistic, random universe could not only be known, but controlled and acted upon. There was less fear of a non-deterministic universe because there were now tools for understanding and controlling it. The erosion of determinism does not herald the decline of power, but its rearrangement through new sets of knowledge relations. In Hacking's (1990) words, with the rise of statistics, chance was tamed.

These shifts in statistics would have important consequences for 20th-century politics. Numbers had come to have a privileged position in the politics of truth (Porter, 1995). The status of the number as a social fact no longer depended on a rhetorical trick, where their sparseness attests to their trustworthiness (Poovey, 1998). Rather, properly collected numbers are a simulacrum of the randomness of the universe, and the key to grasping it (Desrosières, 1998; Porter, 1986; Hacking, 1990). Moreover, the way that statistics was tied up with problematic, even odious, political projects of moral reform and racial purity shows how much politics is implicated in the construction of statistical knowledge and its associated techniques of data collection and analysis. Like their moral statistician forebears, statisticians today would likely dismiss such linkages, but they highlight the political work of seemingly neutral numbers. The decline of determinism was not just a shift in how knowledge and science was understood. It also involved a shift in the kinds of knowledge informing the practice of government. As deterministic knowledge declined in prestige, so the ability of statistical knowledge to model a probabilistic universe was favoured. Moral science and eugenics both implied a link between statistical knowledge and control – of social pathologies and supposed racial degradation respectively. This unspoken linkage still underpins the utility of statistical knowledge.

One consequential outcome was the inauguration of a worldview in which 'theory' was not about God's plan and its attendant moral implications, as conceived under determinism, but an abstraction that made visible a new object – society (Porter, 1986). This object had particular regularities, characteristics, processes, and tendencies that could be measured and acted on. A new scientific discipline – sociology – emerged that would claim this object as its own (Bayatrizi, 2009). And government had a new object to which to direct its attention. In the middle decades of the 20th century another, similar, object appeared – the economy – that also had statistically measurable characteristics and regularities, such as GDP. It became a key object of governmental attention in the second half of that century (Mitchell, 1998, 2002). By the 2000s, statistical data and reason was highly valorised, and when combined with the exponential growth of computing power, 'big data' was born. This brought with it new assumptions about the production of knowledge in which

abstract 'theory' is increasingly subservient to mining for correlations in giant datasets, if not completely subsumed by it (Mayer-Schönberger and Cukier, 2014; Anderson, 2008).

III The geographies of statistics

This section will outline three different geographies of the statistical enterprise drawn from a review of critical literature invoking statistics as a socio-technical practice. First, the geography of statistical institutions and agencies, followed by the geographies of 'datafication', and third, the geographies produced by statistical forms of knowledge. If the history of statistics shows how it is premised on governing in an indeterminate universe, then the geography of statistics can show the kinds of spatial formations through which this government is realised. This is the task of this section.

1 Statistical institutions and agencies

The first geography is of the institutions and agencies with the capacity to maintain, analyse, and distribute statistical knowledge. This is, on the one hand, a geography of scales and networks, and on the other, a topography of statistics-producing actors. Capturing the complexity of this over time is a near impossible task here, as it includes governmental institutions, international organisations, universities, research institutes, firms, formal and informal networks, libraries, databases, banks, third sector agencies, and private individuals, amongst other statistically-interested entities. With this in mind, I try to capture the geography of statistics that existed over three periods: the period from the late 18th century to around the outbreak of the Great War (referred to below as the 19th century); the period through the middle and later stages of the 20th century (the 20th century); and the period from the late 20th century to the present (the 21st century). Obviously, each period is more complex than I can do justice to, and the key innovations of each period have long histories underpinning them. But they do line up with three distinct transitions apparent from the literature. Each transition, in their beginnings at least, have been accompanied by a flush of enthusiasm for what statistical forms of knowledge might allow for (Barnes, 2013).

The 19th century saw the emergence of statistics as a pivotal part of public life in Europe. European states started to value statistical forms of knowledge, leading to government departments and ministries being created to collect statistics, such as the Department of Statistics at the Board of Trade in Britain (Woolf, 1989; Cullen, 1975). Elsewhere in Europe, statistics were collected at the provincial level (Desrosières, 1998). Beyond the state, 'moral statistics' were being collected by academics of various stripes and enthusiastic amateurs, such as those associated with the Statistical Society of London (Cullen, 1975).

While in Britain there was a relationship between the state agencies and those outside of it, the balance of amateurs, academics, and state-sponsored statistical collection varied across the continent (see Desrosières, 1998; Porter, 1986; Hacking, 1990). In France, there was a strained relationship between state statisticians and academic statisticians (Desrosières, 1998). In Germany, statistics were a state activity but only collected at the provincial level and not aggregated, or even commensurable, at the level of the state (Tooze, 2001). Nonetheless, there was correspondence between statisticians in different countries, and efforts to construct networks. Quetelet founded a number of statistical associations inside and outside Belgium connecting statisticians across the continent, including the international statistical congresses held between 1853 and 1878, forerunner to the International Statistical Institute founded in 1885 (Desrosières, 1998; Stigler, 1986). Outside of Europe, statistical activity was more limited. In the US, the decennial census was mainly about population numbers for representative purposes. Moral statistics found their way down

imperial networks to the colonies as colonial elites sought to use the same logics of social reform intended for the poor in Britain on the indigenous peoples of New Zealand and Australia (Rowse and Shellam, 2013). By the end of the century, state agencies in the colonial world were collecting statistics as part of the project of empire (Roberts, 1999; Goswami, 2004; Mitchell, 2002; Kalpagam, 2014).

Looking back from the present, the geography of statistics that emerges during the 20th century involves a shift in scale. Globally, far more statistics were produced, and not just in Europe and its empires. But significantly, institutions that to us exist at a scale 'above' the nation-state became more important to the production of authoritative statistics. This came to pass in the second half of the 20th century as a result of the crisis and chaos that gripped the imperialist-capitalist world in the first half.

A new kind of social statistics – economic statistics – would dominate this period. In Germany, France and other European countries too, experiments in measuring economic activity were occurring from the late 19th century (Tooze, 2001; Desrosières, 1998; Studenski, 1958). In Cambridge, England, a soon-to-be-influential group of economists, including John Maynard Keynes, began investigating empirically-grounded, statistical forms of economics (Lepenies, 2016). The US government had developed an interest in statistics on the business cycle, but with the Great Depression, official measurements of 'national income' began. While there was variation across these countries, they were not isolated. The British economists, including Keynes, were in contact with the Americans, for example (Masood, 2016). But as they coalesced around the new figure of 'the economy' in the 1940s and 50s, driving the convergence was not universal agreement around the 'correct' knowledge, as academic convention would have it, but the forging and shaping of a set of international institutions in two wars – the Second World War and the succeeding Cold War. These institutions would shape the production of statistics in important ways.

The Second World War has been called an economist's war because statistical knowledge justified the US decisively spending more on the war effort (Lacey, 2011). Convinced by this statistical contribution, and in league with their allies, both the postwar American state and the reconstruction effort in Europe were partly based on the interpretation of statistical knowledge by a new generation of macroeconomists.[1] The institutions that would oversee the postwar capitalist world order – the International Monetary Fund and World Bank – hold large statistical databases. The Organisation for European Economic Cooperation (later the Organisation for Economic Cooperation and Development or OECD) was premised on the use of statistical economic knowledge (Schmelzer, 2016). Perhaps the most important innovation was the United Nations' (UN) System of National Accounts (SNA), which measured GDP[2] and other now familiar indicators of economic health. While not primarily a statistical institution, the UN and its agencies collect statistics globally (see Ward, 2004). In the decades following the war, these institutions would define standard social and economic statistics. They circulated statistical information, provided advice for data collection and analysis, and encouraged the proliferation of nation-state level statistical institutions (Schmelzer, 2016). Some states adapted this form of statistics for geopolitical reasons – pre-revolutionary China's adoption of the SNA for example (Fioramonti, 2013). For others, aid money was conditional on keeping national accounts (Masood, 2016; Philipsen, 2015). Meanwhile, the communist world had its own statistical methods and records, drawing these institutions into the defining conflict of the age and Cold War agencies like the CIA into the world of statistics in a 'stats war' (Fioramonti, 2013; Assa, 2015).

With the fall of the Berlin Wall, by the end of the century most countries were networked together through the various 'centres of calculation' (Latour, 1987) of these institutions and collecting the same basic statistics. The nation-state system that developed in the conditions of the Cold War was premised on the statistical knowledge overseen by these institutions. The shift from moral statistics to economic statistics had come with a shift in the global geography of power.

In the 21st century this geography of statistics has been shifting again. No longer confined primarily to state institutions and universities, there is now a proliferation of data-collecting and analysing agencies, producing statistical knowledge on multiple overlapping networks. Today statistical analysis conducted by actors 'outside' the formal state would dwarf that conducted within it (Wilson, 2015; Wyly, 2014). The end of the Cold War has been a factor in this shift, changing the geopolitics of statistics from proving the superiority of an ideology to demonstrating competitive advantage (Assa, 2015). The other factor has been the exponential increase in computing power and digital data storage since the 1980s. Before this time, it was primarily the state with the resources and ambition to collect statistics on a large scale, although the possibilities of binary data analysed by computers was becoming apparent in universities through the course of the 20th century (Armstrong, 2019; Van Meeteren, 2019). From the 1980s, private companies and other non-state organisations increasingly valued statistical knowledge, and have had ever greater capacity to store and analyse the information in ways that are often both innovative and alarming (Wyly, 2014). Today, some of the most valuable companies in the world, such as Facebook and Alphabet/Google, make their profits from the sale of user data. Other kinds of agencies also use statistical forms of knowledge. International networks of private firms, universities, philanthropic organisations, NGOs, local governments, and state institutions hold large databases which produce ever-growing numbers of indicators for an increasing range of topics, such as disease transmission, wellbeing, and climate change vulnerability (Rottenburg et al., 2015; Robin and Acuto, 2018; Kelly and McGoey, 2018; Jenkins, 2017). Many of these data-producing and analysing institutions and networks are centred in the Global North (Robin and Acuto, 2018; Kelly and McGoey, 2018).

The change in statistics is part of a new geography of power and policy, with influential new networks reshaping the geographies of policy formation. A feature of these shifts has been changing practices in state statistical institutions: in Europe, for example, where the European Statistical System is seeking to standardise practice across the continent while working with non -state agencies in the collection of big data (Struijs et al., 2014). These shifts may reflect the geography of power this new geography of statistics will underpin (Davies, 2017; Wyly, 2014), but it is worth underlining here again that the story told in this section is broadbrush. It focuses mainly on geopolitical issues and barely mentions the key role of universities in either advancing statistical analysis or in terms of the uneven and sporadic penetration of statistics into different disciplines (on geography, see Barnes, 2001a). I have also understated the prominence of statistical reason in the private sector, particularly insurance, which has historically had a key role in the development of statistical knowledge (Woolf, 1989). Tooze (2001) points out that the rise of scientific management and the modern corporation was necessary for making the collection of economic statistics possible. Nevertheless, I have demonstrated how the shifts from moral statistics to economic statistics to big data have involved a shifting geography of power reflected in the changing statistical institutions, agencies, and networks associated with them.

2 Geographies of 'datafication'

The second geography is the geography of data collection. In simple terms, where does statistical data come from? In their treatise on the prospects of big data, Mayer-Schönberger and Cukier (2014) suggest the world is best thought of as basically unformatted data awaiting 'datafication'. How useful this is as ontology is debatable, but datafication is the focus of this section. Practices of quantification and measurement, where the world is converted into numerical form and then placed on a scale of some kind, involve a number of interpretive decisions and actions (Desrosières, 2015). These include how to attribute particular characteristics or properties to a phenomenon, how to separate it from its context, what measurement scale to use, where to demarcate the population, and sampling strategy selection. These are all topics of debate and discussion in statistical work, but they are also decisions taken by people situated in complex social contexts (Busch, 2017). The work of classification is particularly pivotal. This is the work of 'making things the same' (MacKenzie, 2009) so they can be counted. As Bowker and Starr (1999) point out, classification is ordinary and ubiquitous, and yet profoundly political and consequential, because the labour of classification forms a socio-technical infrastructure that recedes into the background, naturalising the categories statistics measure (Akin and Banfi, 2019) and contributing to the apparent universality of statistics.

The nascent literature on 'the social life of methods' explores these practices (Law, 2004; Law and Ruppert, 2013; Ruppert et al., 2013; Savage, 2013; Ruppert, 2013). This work argues against seeing the work that renders the world into numerical form as reduction, simplification, the removal of colour and depth, and so on (e.g. Masood, 2016; Lepenies, 2016). It argues that the production of numbers and evidence of different kinds is an inherently social process, involving various kinds of social work to make the numbers possible, visible, useful, and communicable. Statistical work is 'social through and through' (Mair et al., 2016: 71; see also Prince, 2014). It is necessary to see the datafication of the world not as reducing it but as constituting it in both new and received ways. It requires the making-up of experts, spaces, networks, infrastructures, techniques, practices, journals, publications, webpages, and myriad other things that go into the construction of a database. Making the database that supposedly 'reduces' the world to a set of numbers involves the complex reorganisation of social and material space (Bowker and Starr, 1999). A geography of datafication needs to account for the material and social arrangements that enable authoritative numbers to be produced.

Engaging with the social life of methods means recognising that there is a geography to methods:

> we need to attend to the lives and specificities of devices and data themselves: where and how they happen, who and what they are attached to and the relations they forge, how they get assembled, where they travel, [and] their multiple arrangements and mobilizations. (Ruppert et al., 2013: 31—2)

Data and the devices that contain it are material, and have a material geography that can be traced (Kitchin, 2014; Jones et al., 2013; Pickren, 2018; Kinsley, 2014; Amoore, 2018). Bates, Lin and Goodale (2016) argue that we should see data not as a 'flow' but as something that 'journeys', with requisite start points, end points, pauses, and breaks. As it travels it is shaped by and shapes different social worlds in households, universities, research centres, government departments, and so on (Ruppert et al., 2013; Espeland, 2015). Data itself can exist in different forms, such as marks on paper, the holes in punchcards, or the 'pits' and 'lands' of a compact disc, with consequences for where

and how it journeys (Armstrong, 2019). But it is not only data that is travelling: so too are statistical techniques, analytical tools, political imperatives, and other aspects that feed into the resolution of the interpretive challenges of datafication, coming together at key data-making sites where interested social networks intersect (Jenkins, 2017).

Socio-technical infrastructures of datafication have characteristics worth noting for a geographer. They are pivotal to what Beer (2016b) refers to as 'metric power' insofar as they render particular things visible or invisible, order and categorise those things, and prefigure judgements, outcomes, and aims for those actors wanting to make use of the statistical knowledge provided. Metric power enables and constrains particular actions, and there are consequences for those people and things that are hidden, ignored, or miscounted (Graham and Shelton, 2013; Hannah, 2001). What can appear to be deliberate ignorance of particular groups, such as the homeless, is often an effect of the inability of socio-material datafication infrastructures to comprehend these groups given the power relations they are based on and the interpretive assumptions built into them (Jocoy, 2013; Marquardt, 2016). These effects will be geographically variable, as 'cascading devices work in different ways to produce different effects in different locations and circumstances' (Ruppert et al., 2013: 39). But there are two important points to make about these infrastructures. One is that they change. For example, from widely-dispersed, paper-based record-keeping dependent on analogue mail systems (Didier, 2007), to digital networks of electronic databases housed in isolated towns and deindustrialised cities (Pickren, 2018; Jones et al., 2013). As they change, so will the geographies of power they comprise and enable. But, and this is the second point, despite the existence of more and less powerful agencies driving these changes, there is no central intelligence in command. As Bowker and Starr (1999: 319) put it: 'We hardly know what we have built. No one is in control of the infrastructure.'

3 The geographies made with statistics

The third geography of statistics is the geography of the spaces that statistics produces. This is not simply the way that statistics can be used to 'represent' space in an abstract sense – such as in maps that claim to reveal relative levels in deprivation across a country, for example – but the way that statistical representation *makes* space (Barnes and Hannah, 2001). The role of statistics in making space derives from its role in making 'population' and 'society' as governmental objects. Following Foucault (2007, 2008), it was the invention of these objects that constituted the modern state, and statistics – the knowledge of the state – was central to this (Hacking, 1990; Porter, 1986; Hannah, 2000). These objects, measured through censuses, surveys, and record-keeping, presuppose a territory, which in turn becomes something that is able to be thought of as a totality: 'a space of equivalence, in both a political and a logical sense' (Desrosières, 1998: 331). Indeed, territory as a bordered, divisible space is produced alongside statistical knowledge from many of the same infrastructural socio-technical practices that produce the latter, such as the geocoding of space or the measurement of regional economic performance (Rose-Redwood, 2006; Painter, 2010). In contrast to Foucault, who argued that the invention of population as a statistical object saw it supersede territory as the primary object of government, Elden (2005, 2007, 2010, 2013) argues that both emerge from a calculative conception of the world as measurable and quantifiable, enabling space to be understood as a bordered territory with a population contained within it. In this calculable space, statistics are central to both the measurement and manipulation of the characteristics of the population and its territory.

Osborne and Rose (2004: 225) underline this point when they state that '*knowing* human collectivities spatially was bound up with projects of *intervening* in such collectivities spatially'. They argue that practices of inscription, including statistical measurement, are central to practices of spatialisation that conceptualise and demarcate space for particular political projects, resulting in practices, projects, and ways-of-seeing that reshape space. In Osborne and Rose's own example, statistics were central to the 'poverty maps' of the Victorian social reformer Charles Booth. Maps like these reinforced a perception of certain spaces as problematic and enabled political projects reshaping the spaces they claimed to represent through reformist policies and slum clearances. The conceptualisation, measurement, and reconstruction of space are bound together with statistics. Similarly, Murdoch and Ward (1997) describe the way that statistics disembedded farms and farmers from their local contexts and into the British economy as an economic sector, enrolling them in a national economic project and making them available for policy reforms that changed farming space. More recently, cities are undergoing a similar process of disembedding. Large databases of information about urban planning, transportation, health, and education, amongst other things, are conceiving of cities as economic, cultural, and social units in and of themselves. These databases make cities into spaces for data-driven intervention and control (Robin and Acuto, 2018; Schindler and Marvin, 2018).

Statistics does not just produce spaces, however; it places them in topological relations with one another. Almost since statistics first emerged, various organisations have sought to drive data standardisation. This drive recognises the work that numbers do to make dissimilar things commensurable and comparable, even across boundaries in space, time, and thought (Porter, 1995). The success of these efforts is a matter for political contestation because of the way that they can fold space together and bring two otherwise distinct places into a comparative relation, often ranked on a numerical index, that can be politically useful (Allen, 2016; Larner and Le Heron, 2002; Öjehag-Pettersson, 2019; Rottenburg et al., 2015). This helps to reproduce national space. Schools, for example, can be compared to national averages of test scores, producing actions oriented towards the national scale that folds in distant places in order to change practices (Lewis and Hardy, 2017). Historically, social statistics have allowed nations to differentiate themselves and make political points about the effects of political programmes or economic development (Morrissey, 2013). After the Second World War, the creation of economic statistics quickly led to international comparisons and a concern for international competitiveness (Tomlinson, 1994) that has only become stronger in the neoliberal era (Davies, 2015). Contestations over statistics occur, however, as particular interests become concerned about how 'close' rivals might be coming, and statistics becomes a way of pushing them away. For example, political battles over the inclusion of finance as a contributor to GDP in the second half of the 20th century have allowed wealthy countries where these activities are centred to maintain their high position in the league of industrialised countries even as manufacturing has moved offshore (Christophers, 2013; Assa, 2015). Meanwhile, the British Treasury rejected the publication of league tables of social indicators for fear that this could place pressure on their policy priorities as other countries' successes get folded into their political debates (Schmelzer, 2016).

The circulating statistics that fold different places into hierarchical topologies lead to the production of another kind of space as well: spaces 'in between' or 'above' national or regional policy spaces where statistical knowledge is collected together and analysed according to particular political priorities and inclinations to produce policy directives based on this statistical view (Jenkins, 2017; Prince,

2016; Öjehag-Pettersson, 2019). Organisations like the OECD are a good example. It uses rankings and benchmarking to ascertain 'leaders' and 'laggards'. For Schmelzer (2016: 37), 'the publication of OECD rankings was a test of the performance of its member states that often sparked public debates and furthered a policy process of convergence toward what the ranking constructed as best practice'. But such spaces perform their in-betweenness 'within' national spaces as well, through international policy conferences and forums (Prince, 2016). One distinctive example of such a space described in Tooze's (2001: 267–8) history of German economic statistics are the 'altars' of statistical information about the German economy created by the Nazi regime during the war. These were rooms with over a hundred charts of statistical information spread on walls and suspended from rails. The topology of the room creates a 'presence' beyond what copies of statistical reports could: 'A man standing in this unique space could feel himself to be in direct command of all of German industry. The Altar-room was not merely a representation of the economy. It provided a unique vantagepoint.' Statistics enables the generation of spaces that themselves arrange other spaces, such as national economic space, in particular ways.

IV Conclusion

The aim of this paper was to outline a geography of statistics that complements and extends the history of statistics literature and its analysis of the place of statistics in configurations of knowledge and power. One aspect of this is overcoming the tension between recognising the role of statistics in producing the figure of the modern state, and the tendency for historical accounts to be methodologically nationalist in themselves. This requires linking the geographies outlined above. For example, I suggested that the geography of 20th-century economic statistics appears to us, today, as an upwards shift in the scale of statistical production to the level of the international through the creation of global statistical institutions. But these very institutions and the statistics that they produce have been central to our ideas of the international and global scale, and our ideas of how they work. The labour of datafication that renders the world in numerical form so that quantitative knowledge takes on its seemingly universal character enables the territorialisation of populations into measurable and comparable national spaces. It is these part-material, part-imagined, national spaces that international institutions claim to know with statistics, creating the scale effect that elevates the latter 'above' those spaces (Legg, 2009). A less methodologically nationalist account of statistics will take seriously the connection between the institutions, the practices of datafication, and the spaces statistics produces.

For example, the critical literature on statistics often treats numbers as if they are weightless. Espeland (2015: 65) puts the ability of numbers to 'spread and travel to so many places' down to their impersonality and capacity to simplify complex information. Jocoy (2013: 398) describes numbers as 'spatially portable'. This obscures the work that is required to make the easy transportability of numbers possible (Allen, 2003). The geography of statistics emphasises the way that material infrastructures are constructed to produce and circulate numbers across space. These infrastructures are not easily built – it has taken decades for the SNA to penetrate into most of the countries in the world, and even then, its coverage is not complete. Nor are they controlled by any singular actor (Bowker and Starr, 1999) – even in countries where the SNA is well-established, such as the US, it remains contested (see Christophers, 2013). Once the infrastructure is in place, we should not assume that the numbers will still travel easily in and out of the various 'centres of calculation', effecting government as they go (Allen, 2003). Statistical systems remain

peopled at various points. It is not so much that we are governed 'by numbers' (Ball, 2015; Miller, 2001), as our bodies and minds are inserted into these number-producing infrastructures. This should be kept in mind as we try to understand the changing statistical assemblages of the 21st century (Wyly, 2014).

Importantly, a geography of statistics complements the history of statistics because it contributes to our understanding of how power works. The geography of statistics is interleaved with the geography of power. This is because the relational topologies produced by statistics transform spatial relations (Allen, 2016; Hoffman and Thatcher, 2019). By constructing hierarchies, it folds space in ways that makes some places more visible than others inside particular 'policy worlds' (Shore et al., 2011; Prince, 2016). These spaces of comparison enable connections through which policies and other techniques and practices can move (Baker et al., 2016; McCann and Ward, 2012; McCann, 2008; Robinson, 2011; Larner and Le Heron, 2002). Statistical knowledge also topologises time. The Maddison Project (see Bolt and Van Zanden, 2014), named for the late OECD economist Angus Maddison, projects GDP figures back to times where not only did GDP not exist as a concept, but nor did our modern ideas of the economy. Nevertheless, statistical endeavours like this underpin the idea that economies have histories, and historical lessons. And so these topologies of space and time underpin narratives told in 'in-between' spaces about economies, societies, cultures, the environment, and anything else statistics are collected on. This is not to suggest that the statistics pre-exist the narratives. Indeed the history of statistics is entangled with the history of economics, sociology, accounting and myriad other 'low' sciences (Porter, 1986, 1995; Poovey, 1998; MacKenzie, 1981; Hacking, 1990). But statistics' claim that it allows us to see further in space and time hides in plain sight its role in the very real construction of a hierarchical world, where particular places and practices are 'best', while narrating a reason for the hierarchy that pushes statistics itself out of the explanation.

In an echo of the decline of 'moral statistics' before it, from this perspective the decline of GDP has less to do with its adequacy for the 21st century than with shifts in the geography of statistics and the ability to narrate the world in new ways. So rather than see the decline of GDP as a result of its reductiveness (Lepenies, 2016), or its failure to cope with changes in the 'real' economy (Coyle, 2014), or the way it created perverse incentives (Philipsen, 2015), the geographical perspective offered in this paper would contemplate the geographies of GDP. This includes the kinds of institutions and agencies producing, circulating, and using GDP figures, the geographies of datafication that provide GDP figures, and the geographies that GDP has produced. It would ask how these are changing, and how they are being challenged by new statistical geographies that offer narratives that are more politically effective in certain times and places. Making sense of GDP's decline requires tracing its journey through the global statistical assemblage it had a hand in making.

The history of statistics shows how statistics are central to a shift in how people are governed, premised on a shift to a model of an indeterminate universe. The geography of statistics shows how this shift works out in the geography of power and the hierarchical spatial configurations that have emerged to make statistical forms of government possible. This does not mean that we should do away with statistics – this would reproduce the false epistemological divide between quantitative and qualitative forms of knowledge that the power of statistics depends on. But it needs to be inhibited. One possibility is not to teach statistics as a set of universal techniques, but as historical practices linked to particular times, places, and political problems (Desrosières, 2015; MacKenzie, 1981). But geography should also continue to

be disruptive of the kinds of universalism that statistical knowledge claims. By tracing and teaching the geography of statistics, we may be able to provincialise it (Chakrabarty, 2000), not back into any particular place identifiable on a map, but to statistics itself as a complex but particular enterprise. This enterprise may be 'global' in both its character and its extent, but it is identifiable, and by telling its geographies alongside its histories, we can, so to speak, bring it back down to earth.

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Notes

1. This is the story told in various levels of detail in the books referred to at the beginning of this paper. For more scholarly treatments, see Desrosières (1998) and Mirowski (2002).
2. Originally, Gross National Product.

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