Chapter 7
Assembling the Geographic Information Market in the United States

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This chapter explores the construction of geographic information markets in the U.S. by focusing on two key elements. These are (1) the development of mechanisms for two kinds of interoperability: legal interoperability (such as the acquisitions process between different government agencies at different levels) and technical interoperability (such as data formats and spatial data infrastructures), and (2) the construction of Intellectual Property (IP) regimes. By exploring these two elements, the chapter shows how information markets (in this case, specifically geographic information markets) are shaped by the combination of institutional, legal, and technical frameworks established within territorial jurisdictions that allocate property rights, enable the dissemination of standardized data, and create conditions for the development and circulation of commercial informational products.

In the past decade geographers have increasingly centered markets as objects of analysis. This has been particularly productive for economic geography, which had hitherto exhibited a historical bias towards the sphere of production, to the relative neglect of the sphere of exchange. Berndt and Boeckler have made a compelling case to study markets and marketization as geographical processes, providing conceptual tools to examine how markets come together in space as heterogenous, deeply situated economic formations (Berndt & Boeckler, 2009, 2012; Boeckler & Berndt, 2013). Although this research agenda promises to deepen our understanding of the spatialities of capitalism, I argue in this chapter that further attention must be paid to the geographical dimensions present in the development of information markets. Understanding information markets geographically is particularly important because with the rise of the digital economy they have become central vehicles for the distribution of goods and services as well as the production and circulation

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of new forms of knowledge. Yet, their spatial dimensions are often hidden from view and obfuscated by popular terms such as "the cloud" and "cyberspace".

The pivot towards the study of markets has coincided with a period of productive examination of the multiple spatialities of digital technologies, encapsulated by the rise of the subfield of digital geographies. In this context, geographers have examined a range of spatial aspects of the digital, from its infrastructural and economic dimensions (Moriset & Malecki, 2009), sociospatial divides (Graham, 2011; Graham & Dittus, 2022), ability to reconfigure networks of economic relations and reshape industries (Alvarez León & Aoyama, 2022; Glückler & Panitz, 2016a, b), co-constitutive nature with space (Kitchin & Dodge, 2011)—particularly in cities, which are increasingly computationally mediated (Graham, 2005; Mattern, 2021)—, the intensified representation of places through digital technologies and social networks (Crampton et al., 2013; Payne, 2017; Wilmott, 2016), the rise of new paradigms of urbanism mediated by digital platforms (Barns, 2020; Clark, 2020), the role of algorithms in producing new geographies (Kwan, 2016) and the persistence of glitches that reveal fissures in said geographies (Leszczynski & Elwood, 2022). This diverse body of work has enriched our understanding of the multiple co-constitutive relationships between digital technologies and space. However, one area that remains relatively underdeveloped, and is nevertheless central to the spatialization of digital information is the geographic dimensions of regulation and market-making as they specifically manifest in the digital economy (Alvarez León, 2018).

In this chapter I argue that the interplay between technical factors and regulatory frameworks (specifically IP regimes) constitutes a mechanism that defines the roles of market actors, enables, and often binds them to operate with circumscribed functions within jurisdictional constraints—all of which can be spatialized at different scales. This argument is inscribed within a budding research agenda in Economic Geography that focuses on geographic dimensions of law in economic globalization (Barkan, 2011; Sparke, 2013). More specifically, I build on scholarship examining how IP and other specialized legal regimes are instrumental in underpinning market-making, and capitalism at large (Christophers, 2014a, b, 2016). Furthermore, since law does not operate in a vacuum, the arguments developed here take seriously the technological architecture of digital goods and services, with a particular emphasis on geographic information. This integration of legal, institutional, and technological factors is intended to contribute to the project of developing a fuller political economy of the *geoweb*, or the myriad forms of geographic information that circulate on the Internet (Leszczynski, 2012), which has become increasingly central in the construction and operations of the digital economy. More broadly, identifying the specific mechanisms through which technological innovation, knowledge generation, and territorialized legal frameworks constitute the geographic information market in the U.S. can help understand, govern, and regulate other digital information markets across geographies and domains.

The first section examines how interoperability is central to the construction of a market for geographic information in the U.S. Two specific types of interoperability are analyzed through their impact in the process of market creation: legal and

technical interoperability. The chapter explores first the issue of legal interoperability, or how laws and policies regulating geographic information at different scales (national, state, county, city) operate together in the commercialization of this good. The focus then shifts to discuss technical interoperability, or the mechanisms that enable the production and dissemination of standardized and homogeneous data. Two specific elements are highlighted: the TIGER file format developed by the U.S. Census Bureau, and the National Spatial Data Infrastructure, an overarching architecture for the standardized production and distribution of geographic information.

The second section of the chapter focuses on IP regimes of geographic information in the U.S. This examination focuses on the national scale, and particularly on the works produced by the Federal Government. The chapter proceeds to analyze the commercial aspects of the geographic information collected by two of the principal Federal agencies engaged in this activity: The U.S. Geological Survey and the U.S. Census Bureau.

Together, the IP regimes of geographic information produced by governments at different scales, combined with the mechanisms developed for legal and technical interoperability provide the architecture of the geographic information market in the U.S. By focusing on the relations and interactions between these elements, the present chapter advances the understanding of information markets grounded in technical and institutional dynamics shaped by the legal and political economic context of each particular jurisdiction. In the case of the U.S., the dynamics between the legal foundations of IP, the relationship between different branches and levels of government, their role in the market as producer and/or competitor, interact with the institutional logics regulating data production to create the conditions for a growing geographic information market and geospatial economy. This chapter shows how the construction of digital information markets is far from a spontaneous process and more than a technical one, since it is actively shaped by the legal, political, economic, and institutional conditions that are anchored in territorial jurisdictions and simultaneously unfold across administrative scales. Ultimately, understanding how information markets are assembled, and the geographic dimensions of this process, can help illuminate some of the key dynamics of a capitalist economic system that is increasingly reliant on the commodification and digitization of knowledge intensive goods.

Interoperability as a Building Block of Market Construction

Legal Interoperability

The legal landscape regulating geographic information in the U.S. is characterized by the interaction between rules set at various levels by an institutional configuration that includes, among others, federal and state laws, governmental initiatives,

federal, state, and municipal agencies, administrations, and decisions made by courts at various levels in the state and federal systems. Legal interoperability refers to alignment and harmonization of different legal frameworks, and which allows actors and organizations across jurisdictions to streamline the process of working together. This harmonization can take place vertically as well as horizontally across political scales. For instance, the National Interoperability Framework Observatory of the European Commission describes this relationship across scales in the following terms: "[Legal interoperability] might require that legislation does not block the establishment of European public services within and between Member States and that there are clear agreements about how to deal with differences in legislation across borders, including the option of putting in place new legislation" (National Interoperability Framework Observatory and European Commission, 2023, n.p.).

Depending on its state of development, legal interoperability can be either an impediment or a facilitator to the adequate circulation and use of geographic information in society (Onsrud, 1995, 2010). Creating such conditions is critical for the construction and operation of a market that relies on the continuous recombination of informational inputs and their transformation into innovative applications. Therefore, to understand the configuration of the geographic information economy of the U.S. it is essential to identify how interoperability enables this process. This subsection focuses on legal interoperability, which works in conjunction with technical interoperability, covered in the following subsection.

Statutes such as Copyright Law (Title 17 of the U.S. Code) outline the protections that apply to geographic information depending on factors such as its producer and format. For example, data produced by the Federal Government is considered "government work" and in part of the public domain. On the other hand, Copyright applies differentially to data produced by private parties or subnational governments, often depending on the type of geographic information. Maps, for instance, have been a protected category in Copyright Law since the first act of 1791. However, as maps have become digitized, they are often divided into various components, principally the pictorial or graphic map and the underlying database. While Copyright Law continues to protect pictorial maps, the protection of databases is much more contingent. In an increasingly digitized economy, this uneven protection has become a source of contention.

Databases, which in the era of big data make up the majority (and often the most valuable) share of geographic information, are not necessarily protected by Copyright in the U.S. Resulting from a Supreme Court of the U.S. decision in the case of Feist v. Rural in 1991, databases are considered compilations of facts and thus fail to meet the originality requirements to be protected by Copyright. Consequently, databases are often under the much more variable protection of Contracts Law, which may in some cases result in even stronger safeguards than Copyright Law (Karjala, 1995; Reichman & Samuelson, 1997).

The distribution of geographic information produced by the government such as census data and topographic maps is in principle regulated by law. However, there is often flexibility for practice, clarified by policy documents such as the OMB

Circular A-130 (discussed in the second section of this chapter), which prohibits federal agencies from deriving additional financial resources from the distribution of government information and instructs them to recover only development costs (Branscomb, 1994, p. 161).

While this regulatory framework places most of the geographic information produced by federal agencies in the public domain, there remains a great deal of variation in the practices and rules involving states, counties, and municipalities. Within the states, this is often settled in the courts at various levels from trial, to appellate to state Supreme Courts. However, depending on the jurisdiction where a case is heard, it can move through the federal or state court systems. Some of these cases may eventually be adjudicated in the Supreme Court of the U.S. This was the trajectory of the landmark case on databases Feist v. Rural, which was initially decided in the U.S. District Court for the District of Kansas in 1987, and subsequently overturned by the Supreme Court of the U.S. in 1991. Due to the jurisdictional hierarchy in the judicial system, decisions made in the nation's Supreme Court can set a legal precedent for the entire country. Thus, while courts adjudicate cases and rule on specific issues relative to geographic information, such rulings are not necessarily consistent or all encompassing, and may be contingent on specific case histories and jurisdictional variations.

As a result of this complex patchwork of regulations and jurisdictions, organizations such as the National States Geographic Information Council work in the interstitial space provided by the judicial system and focus on developing a standardized set of practices for geographic information across the country. While the legal aspect of interoperability remains elusive to the intrinsically fragmented government system of the U.S., it is complemented by technical advances facilitating the nationwide production and use of standardized geographic information. Overarching projects such as the National Spatial Data Infrastructure (NSDI) can partially bridge the gaps between legal regimes governing geographic information in the U.S. The NSDI seeks to streamline processes, enforce standards, and harmonize practices in the production, distribution, and use of geographic information throughout the country. This and other initiatives to advance technical interoperability have become key elements in the geographic information economy of the U.S.—especially since the ascent of digital information as a key economic asset. In part this is because the distribution and application of geographic information require up to date guidance, which the law is often unable to deliver.

Thus, while legal interoperability is a desirable objective, it must be complemented in practice by technical interoperability. Building information markets, then, requires the interplay of legal and technical interoperability, even while each moves at different rhythms and focuses on disparate elements, such as standards, formats, rules, and practices for geographic information throughout the country. The next subsection discusses two building blocks of technical interoperability for geographic information in the U.S.: (1) TIGER, a format created by the Census Bureau and (2) the National Spatial Data Infrastructure.

Technical Interoperability: Standards and Formats

TIGER format

Known to most users of U.S. Census Bureau data, the TIGER[1] data format was first developed during the 1960s and 1970s by the U.S. Census Bureau. Its development was motivated by two linked concerns: (1) to digitize the Census process, and (2) to create a national cartography of roads and boundaries for the decennial Census that could then be linked to all other data collected by the Bureau (Bevington-Attardi & Ratcliffe, 2015; Cooke, 1998). The resulting database produced an impact well beyond its initial objectives, and "has generated the largest civilian use of maps and mapping technology supported by the United States Federal Government" (Bevington-Attardi & Ratcliffe, 2015, p. 63). This technological innovation took place in a number of research teams in the Census Bureau and is a result of the productive interaction between staff and resources at this federal agency and research universities—particularly between the Bureau's New Haven Census Use Study of 1967 and researchers at Yale University (Cooke, 1998).

TIGER is an example of how the production of knowledge is mediated by the specific configuration of the institutions that produce it. In this case, the institutional geography of the Census Bureau played an important role in creating the conditions for this technological breakthrough. As Cooke has argued, the reconstitution of the New Haven Census Use Study into the Southern California Regional Information Study and its consequent relocation from Connecticut to Los Angeles provided this group with the relative freedom to innovate within the centralized governance structure of the agency (Cooke, 1998, p. 54). From these conditions emerged an innovative file format capable of representing topology in a practical and efficient way and that was easily adapted to new computing technologies. Furthermore, the fact that DIME/TIGER was created by a government agency was instrumental in the diffusion, national coverage, and massive use of this format.

In parallel to this, California-based ESRI (a leader in the GIS industry) developed a separate file format for their software ArcView in early 1990s, the *shapefile*, which would become the standard for non-topological geographic information (Theobald, 2001). While the shapefile is proprietary and therefore its development and evolution are ultimately controlled by ESRI, the company has published its specifications, adding a degree of openness to the format. The shapefile has become a global standard of use due to a combination of its feature-centric manipulation enabled by an increase in computing power and the market dominance of this company's software packages, such as ArcGIS and ArcView (DiBiase, 2014; Theobald, 2001).

[1] TIGER stands for Topologically Integrated Geographic Encoding and Referencing. Prior to this acronym, the format was initially known as Dual Incidence Matrix Encoding, and later Dual Independent Map Encoding (DIME).

On the other hand, since their appearance in the 1980s, TIGER format files have become crucial in collecting, organizing, and distributing topological geographic information, particularly by government agencies. Its development by the Census Bureau, use as a store for all topology, and linkage to its vast catalog of statistical data made the TIGER format a de facto standard across U.S. government agencies and administrations. Furthermore, as argued by Cooke, this format's impact as catalyst for of the geographic information economy was evident already in the 1990s: "[TIGER's] success has put the world's most useful general purpose spatial database into the hands of more users than any other GIS data resource. The current boom in business geographics is only possible because of the groundwork laid by the Census Geography Division in building TIGER" (Cooke, 1998, p. 56).

These two concurrent developments—TIGER, by a government agency, and the shapefile, by a private firm—have often been combined and distributed together, as the Census Bureau has done since 2007 through the distribution of TIGER/LINE shapefiles. This increases the reach of both formats and makes them easier to download and manipulate by GIS users. However, despite the success and wide distribution of this combination, the shapefile remains a proprietary format whose "openness" is mostly a pragmatic decision resulting from the market power of ESRI's software package ArcGIS. In this context it should also be highlighted that the efforts of the Census Bureau in developing a topological standard for digitized geographic information created the initial conditions for massive distribution of geographic datasets and enabled government agencies across the U.S. and private users everywhere to collect and distribute geographic information with increased efficiency. In this way, the innovation in knowledge and technology that emerged from the informational needs of the Census Bureau became a fundamental building block for the construction of the geographic information economy in the U.S., and beyond.

The National Spatial Data Infrastructure

A second key element in developing technical interoperability for geographic information in the U.S. is the National Spatial Data Infrastructure (NSDI). This nationwide project started in 1994 with President Clinton's Executive Order 12906 (the Plan for the National Spatial Data Infrastructure). This order was issued in recognition that digitized geographic information was not only increasing in value but was rapidly becoming essential for all types of decision-making in government as well as in industry. The NSDI thus responded to the need for standardizing the collection and distribution of geographic information across agencies and scales of government in the U.S. As a collection of technical standards, policies, and procedures coordinated by the Federal Geographic Data Committee, the NSDI's goal is to align institutional practices over geographic information from the federal level. This is particularly important considering the disparate regulations, capacities, and incentives that shape the practices of production and distribution of geographic information across governmental institutions.

While the TIGER format developed by the Census Bureau is centered on the technical specifications of geographic information digitization and encoding, the NSDI encompasses the broader architecture in which said information is collected and transmitted within the U.S. government. Together, these two elements combine to increase the technical interoperability that underpins the geographic information economy in the U.S. This combination can sometimes lead to trade-offs between usability and openness. As was mentioned above, the Census Bureau opted to distribute TIGER shapefiles due to the compatibility with most Geographic Information Systems. The question here is whether the higher restrictiveness implicit in favoring a private firm's proprietary format is counterbalanced by the widespread usage this very format may foster. This is not only a technical, but a political decision that can have ramifications for an entire spatial data infrastructure, in this case for the U.S.

In fact, similar considerations have been central to the design of INSPIRE, the spatial data infrastructure of the European Union. INSPIRE has developed a collection of standards and procedures aimed at producing uniform geographic information datasets across all member states. Part of this overarching project is the use of the GML, or Geographic Markup Language, file format. This is a type of encoding for spatial data based on XML language and developed by the Open Geospatial Consortium. It was selected by INSPIRE due to its status as an open data format. However, this normative choice comes with its own set of trade-offs. In the hopes of making the geographic information in the EU as open as possible and allowing its access by the broadest number of users, INSPIRE's choice of the GML format inadvertently made it more restrictive in practice. This is because GML generally requires a high degree of technical expertise and is not as compatible with many GIS programs as some proprietary formats.

In contrast to INSPIRE, the NSDI's support of the GML format has been more gradual. While the openness of the format can increase technical interoperability between geographic information users and producers, its technical specifications remain beyond the reach of most users. A pilot study done at the Geography Division of the Census Bureau attempted to "utilize the GML standard to organize and present national scale TIGER data" (Guo, 2013, p. 91). This study found that such utilization still has major issues related to data volume, comprehensive data organization, and document naming (Guo, 2013).

Considering the difficulties of transitioning to, and enforcing, a truly open format that can operate across a nationwide spatial data infrastructure like the NSDI, the trade-offs made by most government agencies in the U.S. are telling in some key respects. While the Census Bureau's own TIGER database is still the "the most comprehensive geographic dataset with national coverage in the US" (Guo, 2013, p. 82), it is noteworthy that the Bureau has supported its release in ESRI's proprietary shapefile format as well as a variety of other popular formats, such as Google's KML, which became an open standard in 2008 (Kirkpatrick, 2008).

This decision by the Census Bureau to opt for widespread distribution over strict openness is suggestive of the larger philosophy characteristic of U.S. governmental agencies' involvement in the geographic information economy. In the development of technical interoperability, they have opted to maximize the circulation of

geographic information produced by the government. This decision encapsulates a powerful logic underpinning the construction of the U.S. geospatial market, where the Federal Government's technical decisions make its informational products widely available while catalyzing economic externalities that can benefit individual firms like ESRI or Google. This practice aligns with prevailing policy regarding the US government's role in the information economy as a producer of informational inputs, with boundaries defined through the legal instruments discussed in the next sections of this chapter.

Government Works and the Federal Level

Legal Status of Federal Government Works

Under Title 17, section 105 of the U.S. Code, the category of Government works[2] in the U.S. is part of the public domain, which means that no actor can exert Copyright protections and thus ownership over it. This allows for the dissemination, transformation, and use of government works by anyone, for commercial and non-commercial purposes, both within and outside the U.S. Abroad, however, the U.S. government reserves the right to assert Copyright of its works (U.S. Copyright Office, n.d.; U.S. Government, n.d.). This legal regime covers informational works of any kind produced by the Federal Government of the U.S. not considered 'classified' due to national security.

Historically, U.S. Federal agencies have only charged users for reproduction costs to maximize the public access to government information. However, during the 1980s and 1990s there was a policy shift to pricing based on the public's willingness to pay, which was met with stiff resistance from civil society groups. Soon after, the Office of Management and Budget, through Circular A-130 reversed this trend by instructing "government agencies to recoup only the costs of reproduction of government information and not to derive additional financial resources to recover development costs" (Branscomb, 1994, p. 161). Thus, while the Federal Government may charge for information, it may only do so strictly to cover costs of reproduction. This limitation in revenue generation is the defining quality that establishes the Federal Government's role as an information producer and prevents it from competing directly in the market for informational goods. The Federal Government's information production is financed through taxes and made publicly available to fulfill three main goals: (1) disseminate public information, (2) support government decision-making, and (3) produce inputs for commercial development.

It is particularly the third point that is key to construction of the informational economy of the U.S. As noted by Wells Branscomb, the limited scope of action of

[2] Except for Standard Reference Data produced by the Secretary of Commerce, as indicated in the Standard Reference Data Act of 1968.

the Federal government with respect to the commercialization of information is emphasized in OMB circular A-130, which "also warns government agencies not to interfere or attempt to restrict secondary uses of information resources, leaving the private sector to take what it will and reproduce it either as is or with value-added services" (Branscomb, 1994, p. 161). Such explicit delimitation establishes a clear division of labor in the U.S. information economy where the Federal Government is the supplier of informational inputs to the private sector.

The rules mentioned above not only shape the informational economy in the U.S. in general terms, but the specific markets for different kinds of information, such as geographic information. While geographic information is a constantly expanding category, it can be defined by data that are either directly georeferenced or somehow linked to specific locations and places. This includes a vast array of spatial representations that range from maps to aerial and satellite imagery to climatologic, demographic, statistical, and economic datasets. Increasingly, geographic information includes data produced by users through digital technologies such as mobile phones and social media applications, and disseminated through online portals, all of which allows for their rapid and efficient transmission, transformation, and recombination.

The technological change introduced by digital and later networked technologies has important implications for the geographic information economy, and particularly for the role of the Federal Government as a producer of this good. For one, these technologies make it easier to collect, organize, and distribute information. This lowers the cost of public distribution from single access points, such as the Census Bureau's American FactFinder, which hosts demographic, economic, and statistical data, or the USGS's Landsat Earth Explorer, an online archive of satellite imagery.

On the other hand, these technologies place an increased burden of immediacy, expediency, and efficiency on government information producers. While strictly speaking U.S. Federal agencies are not market actors, they compete with private services for the online attention of users. These services, such as Google Earth, Google Maps, and ArcGIS.com generally offer the same government-collected primary data repackaged in more accessible user interfaces and supplemental features. This supplier/competitor online relationship between government agencies and private firms exemplifies some of the reshuffling precipitated by new technologies in the geographic information economy.

While the role of the Federal Government as information producer in the information economy is clearly delimited by regulations such as OMB Circular A-130 mentioned above, it is also subject to change through the relations and linkages to other market actors. In the face of technological change and new demands placed by society in terms of access and distribution, Federal agencies often partner with private firms for the collection and dissemination of public information. While this is a common practice, government partnerships with the private sector have raised important questions about the control of the informational resources and the role of those private firms as competitors in the market.

A suggestive example is the merging of data from two online portals of the Federal Government, Data.gov and Geodata.gov, in 2010. In 2005 the Department of the Interior had awarded the contract to develop Geodata.gov to the private firm ESRI, the market leader in geographic information systems (U.S. Department of the Interior, 2005).[3] Then in 2010 the same firm was awarded the contract to link Geodata.gov with the existing government portal Data.gov (Schutzberg, 2010). This represented an important step in developing a "one-stop shop" for the concentration and distribution of all types of geographic information produced by the U.S. Federal Government.

However, ESRI's involvement in linking the data and maintaining this service led to a controversy due to the firm's status as the GIS industry leader as well as the favored access and input control suggested by the firm's maintenance of the Geodata.gov portal (Fee, 2010; Pomfret, 2010). By maintaining this portal ESRI would be in a position to redirect user traffic to their free online service ArcGIS.com, which would in turn allow users to create map mashups using data layers from Geodata.gov (Sternstein, 2010). The government would pay ESRI $50,000 to undertake the data linkage project. This was an unusually low figure compared to the true cost, which was estimated by the firm's president, Jack Dangermond, in the tens of millions of dollars—an amount which, as he explained, would be supplemented through licenses (Sternstein, 2010).

The connection with ESRI's online service, compounded by the low cost of the contract drew criticism from some members of the geospatial community, who saw this as preferential treatment to a market leader that amounted to the government funneling users of a public service to a private platform while in the process generating traffic and advertisement benefits for the said platform (Fee, 2010; Pomfret, 2010). While ESRI later issued a clarification stating that Geodata.gov would be only one of the many sources of spatial data available to users of ArcGIS.com (Schutzberg, 2010), this episode highlights the tenuous line separating the production of public information by the government and the commercial implications that can arise from the involvement of private companies in its online distribution.

Geographic Information in the U.S. Geological Survey and the U.S. Census Bureau

The U.S. Geological Survey (USGS) is part of the Department of the Interior. It is a scientific agency whose principal mission is to collect and distribute reliable geographic information for the understanding of the Earth, hazard mitigation, resource management, disaster prevention and quality of life improvement (U.S.Geological Survey, 2014). The USGS furthers these goals through outputs such as topographic

[3] This is known as Version 2 of the Geodata.gov portal. ESRI had previously been awarded the contract for Version 1, launched in 2003.

maps, digital elevation models, soil analysis, orthophotography, aerial and satellite imagery, among others. As a Federal agency, its informational products are considered "government works" under section 105 of Title 17 of the U.S. Code, and thus constitute public information, except for certain primary data sourced from private firms under contract.

Part of the mission of the USGS is to maintain a public access point for their informational products. In recent years the USGS has pioneered several online initiatives to make comprehensive spatial datasets available to the public. One of the USGS's principal projects is the National Map, made in collaboration with local, state, and federal agencies. This online portal hosts "a seamless, continuously maintained set of public domain geographic base information that will serve as a foundation for integrating, sharing, and using other data easily and consistently" (Dewberry, 2012, p. 31). In addition to the National Map, USGS has partnered with NASA to administer the Landsat satellite program and to offer the entirety of their imagery archive through the Earth Explorer portal. While most of the data can be directly downloaded, imagery that is not yet online can be requested for digitization for the charge of reproduction costs (U.S. Geological Survey, 2016). This constitutes a peerless archive of publicly available satellite data dating to the 1970s and spanning the entire globe.

The USGS engages with many local, state, and federal government agencies, as well as and private actors and other sectors of the public to determine their needs for geographic information and assess the potential benefits. While its aim is to further scientific endeavor, it does so with a keen eye on the applications, societal, and economic impact of its informational products. For example, for the National Enhanced Elevation Assessment, which collects updated elevation data for the entire country, the USGS conducted a detailed cost-benefit analysis that included the full documentation of "business uses for elevation needs across 34 Federal agencies, agencies from all 50 States, selected local government and Tribal offices, and private and not-for profit organizations" (USGS, 2014). The final report, conducted by the consulting firm Dewberry (2012), identified a benefit for 27 business uses ranging from management of flood risks, infrastructure, and construction, to urban and regional planning as well as health and human services. Table 7.1 shows these 27 business uses considered in the National Enhanced Elevation Assessment of the USGS. The benefits estimated across these business uses ranged from a conservative figure of $1.18 billion to a potential of $12.98 billion. According to this report the annual combined highest net benefit for federal, state, and non-governmental actors had a benefit/cost ratio of 4.728 for every dollar spent, yielding $795 million per year (Dewberry, 2012, p. 8).

This economic calculation is indicative of the general operating practices of the USGS and shows awareness of the agency's role as the centerpiece of a 'system of engagement' in which geographic information is the key resource and catalyst of economic activity. As indicated by a senior executive at the USGS National Geospatial Program, this and other federal agencies have adopted an 'entrepreneurial' strategy, seeking a return on investment, and avoiding competition with the

Table 7.1 Business uses and estimated benefits of the National Enhanced Elevation Assessment (in $US Millions)

Business use	Conservative benefits	Potential benefits	Difference (Potential minus conservative)
Flood risk management	294.71	501.58	206.87
Infrastructure and construction management	206.21	941.95	735.74
Natural resources conservation	159.23	335.15	175.93
Agriculture and precision farming	122.33	2011.33	1889.00
Water supply and quality	85.29	156.35	71.06
Wildfire management, planning and response	75.70	158.95	83.25
Geologic resource assessment and Hazard mitigation	51.75	1066.75	1015.00
Forest resources management	43.95	61.66	17.71
River and stream resource management	38.42	86.58	48.16
Aviation navigation and safety	35.00	56.00	21.00
Coastal zone management	23.79	41.74	17.96
Renewable energy resources	10.05	100.05	90.00
Oil and gas resources	10.00	100.00	90.00
Homeland security, law enforcement, disaster response	9.98	126.47	116.49
Sea level rise and subsidence	5.78	21.66	15.88
Urban and regional planning	4.20	68.57	64.37
Resource mining	1.69	4.86	3.18
Wildlife and habitat management	1.51	4.02	2.51
Education K-12 and beyond	0.26	2.26	2.00
Land navigation and safety	0.19	7124.88	7124.68
Telecommunications	0.19	1.85	1.67
Recreation	0.05	0.05	0.00
Cultural resources preservation and management	0.00	7.00	7.00
Health and human services	0.00	1.00	1.00
Marine navigation and safety	0.00	0.00	0.00
Real estate, banking, mortgage, insurance	0.00	0.00	0.00
Rangeland management	0.00	0.00	0.00
Total estimated annual Dollar benefits	1180.22	12,980.71	11,800.48

Note. Source: Adapted with data from Dewberry (2012, p. 5). Design by author

private sector to do things "better", but rather doing them "differently".[4] This is consistent with the USGS's complementary role in the market as information producer whereby it connects the interests of local, state, and national actors, private and public while aiming to balance their needs. As suggested by the wide range of business uses indicated above, one of USGS's priorities is to nurture the market for geographic information by supplying informational inputs with an explicit consideration for the development of secondary applications.

Located within the Department of Commerce, the U.S. Census Bureau is a federal agency whose mission is to "serve as the leading source of quality data about the nation's people and economy" (U.S. Census Bureau, 2023). These data are collected through projects such as the constitutionally mandated Decennial Census, the Economic Census, the Census of Governments, the American Community Survey, and a number of other surveys and economic indicators (U.S. Census Bureau, 2023). While the Census Bureau is not strictly a mapping agency, it has played a fundamental role in the production of geographic information in the U.S. This is a function of the Bureau's need to aggregate and georeference their data at scales ranging from states to census tracts, block groups, and blocks, which is essential to accomplish its four principal uses:

1. the constitutionally mandated distribution of congressional seats to states
2. make planning decisions about community services
3. facilitate the annual distribution of federal funds to local, state, and tribal governments
4. provide age search information for activities such as Social Security qualification, passport applications, relationship verification for real estate sales, and historical research, etc. (U.S. Census Bureau, 2023)

The comprehensive mapping of the Bureau has been enabled by its development of technical innovations, such as the TIGER/LINE format, a cornerstone of technical interoperability in the U.S. geographic information economy, as discussed earlier in the chapter.

Like the data produced by the USGS, the data collected by the Census Bureau is considered under the category of "government works", which places them in the public domain and not protected by the U.S. Copyright Act. However, to a greater degree than other federal agencies, the Bureau places a clear boundary around publicly available to safeguard the privacy of respondents by enforcing confidentiality over data that may be personally identifiable. Publicly available data comprise those at the scales of state, city, highly populated census tracts, and block groups. On the other hand, data from thinly populated census tracts and blocks are considered confidential.

The operations of the Census Bureau are bound and regulated by two laws: Title 13 and Title 26 of the U.S. Code. Title 13 specifies the operations of the Bureau and establishes its mandate of confidentiality, while Title 26 regulates the provision of

[4] Interview with senior personnel at the USGS National Geospatial Program. March 2016.

tax information to other federal agencies, including the Census Bureau. The specific content of the questions in the Census and the budget to carry it out are subject to Congressional approval, which entails a continuous process of negotiation, and can often lead to heated political controversies, such as the decision taken during the Trump administration to include a citizenship question in the 2020 Census.

While the Census Bureau is a federal agency, its data collection and operations throughout the national territory require engagement with agencies at all levels of government. One key reason for this is that much of the geographic information at the local scale, which is considered the most valuable, is sourced directly from counties and municipalities. Cross-scalar engagement presents challenges for the Bureau, since it must often negotiate the acquisition of the rights and licenses to data that—unlike at the federal level—are not covered under the government works designation, but by a patchwork of state and local regulatory and property regimes.

Unifying and standardizing these diverse data sources requires a combination of organizational and technological strategies. For this purpose, the Census Bureau developed an in-house platform to verify addresses using GPS. Furthermore, organizationally, each regional office coordinates the acquisition of data with local governments and performs quality controls over each dataset.

The Census Bureau produces these data following its constitutional mandate—which sets a rigid schedule and well-defined objectives. Yet, like the USGS, the Bureau is quite aware of the commercial value of its informational products. As indicated by a senior employee, the Census Bureau's informational outputs have helped catalyze the development of widely used cartographic services, such as the Thomas Brothers Atlas (later purchased by Rand McNally), and Google Maps, both of which use TIGER/LINE topological data as primary inputs.[5] Furthermore, the economic, demographic, and social statistics produced by the Census Bureau are of great value for decision-making in both the government and private industry. The Economic Census, for instance, is particularly tailored for its commercial applications by a wide range of market actors. The Bureau defines the official count produced by this endeavor as "[t]he foundation for business activity across the U.S. economy" (US Census Bureau, 2018). Recognizing its value, the Bureau has divided Economic Census data in five categories for which they have outlined a corresponding set of specific uses, totaling 15. These uses cover a range of activities from measuring GDP to promoting small business and furthering local economic development. These uses, along with the data categories they belong to are reproduced in the Table 7.2.

It should be noted that the label of specific "uses" as employed by the Economic Census conflates two different classifications: entries such as Business Marketing can be considered direct applications of the data, while others such as GDP can be understood as indicators generated through specific variables. This categorical fuzziness notwithstanding, the language employed by the Bureau in identifying such "uses" suggests an attention to the "actionable" qualities of the data collected by

[5] Interview with senior personnel at the U.S. Census Bureau. March 2016.

Table 7.2 Data categories and specific uses of the Economic Census

Data category	Specific uses
Data to understand business competitiveness	Business marketing and performance metrics
	Business investment planning
	Local economic development
Accurate benchmarks for economic indicators	Gross domestic product (GDP)
	Producer price index and productivity
	Retail sales and other indicators
Consistent, comparable, comprehensive measures	Statistics by industry
	Statistics by geography
	Employment, payroll, sales, locations and firms
Information on business location and size	Transportation uses
	Energy impacts
	Promoting small business
Characteristics of U.S. businesses	Industry concentration by firm share
	Franchising
	Owner, sex, race, ethnicity, and veteran status

Note. Source: Adapted from U.S. Census Bureau (2021). Design by author

this institution, and particularly to their potential in catalyzing economic activity. The utilitarian rhetoric used by the Census Bureau underlines how the data collection and distribution activities of this and other Federal agencies, such as the USGS (whose data uses were catalogued above) are simultaneously informed by the imperative of public use and considerations for market potential. Beyond encouraging the diversified application of Economic Census data, this rhetoric has a key function in the institutional logic of the Census Bureau when it is leveraged in budgetary and funding negotiations with Congress.[6]

In sum, while the Census bureau and the USGS are Federal agencies bounded by law and limited in their market action, they are nevertheless embedded in market logic. This leads them to deliberately take on the role of information producers and, beyond dissemination public information to for government and public use, provide inputs directly aimed at developing a broad cross-sectional geographic information economy. While this market logic may not be the main institutional guiding force, it underlies their strategy and action, and is woven throughout the documents, operations, and data produced by agencies like the USGS and the Census Bureau. This is in large part due to the legal and regulatory status limiting the Federal Government from explicitly participating in the market action while orienting the information production of "government works" towards the public domain and the catalysis of economic activity.

[6] Interview with senior personnel at the U.S. Census Bureau. March 2016.

Conclusion

This chapter has shown how IP regimes and other regulations have the power to shape information markets by defining actors and outlining their functions within specific jurisdictions. In the U.S., the prevailing IP regime assigns the role of information producer to the U.S. Federal Government and limits it from participating in the market as competitor. By enforcing the public information regime known as "government works", U.S. Copyright Law simultaneously creates the conditions for the Federal Government to fulfill its mandate to serve the public and engage in the production of inputs for the information economy.

This IP regime is underlined by a separation between the information production and consumption where the government subsidizes the former and implicitly appoints the private sector with value-added activities and engagement in market competition. In tension with this, the chapter argued that the regulatory framework for information, of which IP is one important part, limits the extent to which the government can engage in market actions. Thus, the specific characteristics of the institutional and legal architecture of the government of the U.S. are fundamental in shaping the construction of the (geographic information) economy in this country. Information markets, however, require a great degree of institutional as well as technical coordination. In this context, integrating various mechanisms of interoperability allows for the aggregation and standardization of information from different sources and facilitates their circulation for commercial and non-commercial purposes. As this chapter has argued, two forms of interoperability—legal and technical—combine to regulate the production of knowledge and digital innovations in the U.S. geographic information market while simultaneously defining the spaces where informational goods can circulate, whether they can be monetized, and the range of potential applications and secondary products.

The geographic information economy in the U.S. is characterized by a coexistence of diversity (of regulations, conditions of production, relationships between state and market) and coherence, which is bridged through instruments such as the use of common information formats produced by the government (e.g., the Census Bureau's TIGER format) and their integration with proprietary formats (such as ESRI's shapefile). These technical developments, aimed at maximizing the distribution and use of information, are loosely regulated through the development of cross-scalar and multi-sectoral initiatives (such as the National Spatial Data Infrastructure) aimed at developing standards, but whose relative laxity in enforcing a single set of technical prescriptions benefits the development of flexible solutions that can be mobilized for the marketization of geographic information. More generally, the arguments developed here help explain the role played by specific configurations of legal regimes, technical standards, and processes of knowledge generation in the construction, regulation, and maintenance of

information markets. This perspective, in turn, can be deployed to understand the geographic dimensions of developments as diverse as the European Union's efforts to create a "Digital Single Market", the monetization of personal information on the Internet, the global emergence of markets for new kinds of informational assets such as Non-Fungible Tokens and cryptocurrencies, and other formations that characterize the continuously expanding global digital economy.

References

Alvarez León, L. F. (2018). Information policy and the spatial constitution of digital geographic information markets. *Economic Geography, 94,* 217–237. https://doi.org/10.1080/00130095.2017.1388161

Alvarez León, L. F., & Aoyama, Y. (2022). Industry emergence and market capture: The rise of autonomous vehicles. *Technological Forecasting and Social Change, 180,* 121661. https://doi.org/10.1016/j.techfore.2022.121661

Barkan, J. (2011). Law and the geographic analysis of economic globalization. *Progress in Human Geography, 35,* 590–607. https://doi.org/10.1177/0309132510389221

Barns, S. (2020). *Platform urbanism: Negotiating platform ecosystems in connected cities*. Geographies of Media. Singapore: Palgrave Macmillan. https://doi.org/10.1007/978-981-32-9725-8

Berndt, C., & Boeckler, M. (2009). Geographies of circulation and exchange: Constructions of markets. *Progress in Human Geography, 33,* 535–551. https://doi.org/10.1177/0309132509104805

Berndt, C., & Boeckler, M. (2012). Geographies of marketization. In T. J. Barnes, J. Peck, & E. Sheppard (Eds.), *The Wiley-Blackwell companion to economic geography* (pp. 199–212). Chichester: Blackwell Publishing. https://doi.org/10.1002/9781118384497.ch12

Bevington-Attardi, D., & Ratcliffe, M. (2015). Data visualization at the US census bureau: An American tradition. *Cartography and Geographic Information Science, 42*(sup1), 63–69. https://doi.org/10.1080/15230406.2015.1060149

Boeckler, M., & Berndt, C. (2013). Geographies of circulation and exchange III: The great crisis and marketization "after markets". *Progress in Human Geography, 37,* 424–432. https://doi.org/10.1177/0309132512453515

Branscomb, A. W. (1994). *Who owns information? From privacy to public access.* New York: Basic Books.

Christophers, B. (2014a). Competition, law, and the power of (imagined) geography: Market definition and the emergence of too-big-to-fail banking in the United States. *Economic Geography, 90,* 429–450. https://doi.org/10.1111/ecge.12062

Christophers, B. (2014b). The territorial fix: Price, power and profit in the geographies of markets. *Progress in Human Geography, 38,* 754–770. https://doi.org/10.1177/0309132513516176

Christophers, B. (2016). *The great leveler: Capitalism and competition in the court of law*. Cambridge, MA: Harvard University Press.

Clark, J. (2020). *Uneven innovation: The work of smart cities*. New York, NY: Columbia University Press. https://doi.org/10.7312/clar18496

Cooke, D. F. (1998). Topology and TIGER: The Census Bureau's contribution. In T. W. Foresman (Ed.), *The History of Geographic Information Systems Perspectives from the Pioneers* (pp. 47–57). Upper Saddle River: Prentice Hall PTR. https://doi.org/10.5860/choice.36-2183

Crampton, J. W., Graham, M., Poorthuis, A., Shelton, T., Stephens, M., Wilson, M. W., & Zook, M. (2013). Beyond the geotag: Situating "big data" and leveraging the potential of the geoweb. *Cartography and Geographic Information Science, 40,* 130–139. https://doi.org/10.1080/15230406.2013.777137

Dewberry. (2012). *United States geological survey: National enhanced elevation assessment* (Final report). Retrieved from http://www.dewberry.com/docs/default-source/documents/neea_final-report_revised-3-29-12.pdf?sfvrsn=0

DiBiase, D. (2014). *Shapefiles*. The Nature of Geographic Information. Retrieved from https://www.e-education.psu.edu/natureofgeoinfo/c4_p5.html

Fee, J. (2010, June 2). *ESRI Binding Data.gov and GeoData.gov*. Retrieved from http://spatial-lyadjusted.com/esri-binding-data-gov-and-geodata-gov/

Glückler, J., & Panitz, R. (2016a). Unpacking social divisions of labor in markets: Generalized blockmodeling and the network boom in stock photography. *Social Networks, 47,* 156–166. https://doi.org/10.1016/j.socnet.2016.07.002

Glückler, J., & Panitz, R. (2016b). Relational upgrading in global value networks. *Journal of Economic Geography, 16*, 1161–1185. https://doi.org/10.1093/jeg/lbw033

Graham, S. D. N. (2005). Software-sorted geographies. *Progress in Human Geography, 29,* 562–580. https://doi.org/10.1191/0309132505ph568oa

Graham, M. (2011). Time machines and virtual portals: The spatialities of the digital divide. *Progress in Development Studies, 11*, 211–227. https://doi.org/10.1177/146499341001100303

Graham, M., & Dittus, M. (2022). *Geographies of digital exclusion: Data and inequality*. Radical Geography. London: Pluto Press. https://doi.org/10.2307/j.ctv272452n

Guo, L. (2013). Pioneering GML deployment for NSDI: Case study of USTIGER/GML. *ISPRS International Journal of Geo-Information, 2,* 82–93. https://doi.org/10.3390/ijgi2010082

Karjala, D. S. (1995). Copyright in electronic maps. *Jurimetrics, 35,* 395–415.

Kirkpatrick, M. (2008, April 14). *Google gives up control of keyhole markup language (KML)*. Retrieved from http://readwrite.com/2008/04/14/google_gives_up_control_over_k/

Kitchin, R., & Dodge, M. (2011). *Code/space: Software and everyday life*. Software Studies. Cambridge, MA: MIT Press. https://doi.org/10.7551/mitpress/9780262042482.001.0001

Kwan, M.-P. (2016). Algorithmic geographies: Big data, algorithmic uncertainty, and the production of geographic knowledge. *Annals of the American Association of Geographers, 106,* 274–282. https://doi.org/10.1080/00045608.2015.1117937

Leszczynski, A. (2012). Situating the geoweb in political economy. *Progress in Human Geography, 36,* 72–89. https://doi.org/10.1177/0309132511411231

Leszczynski, A., & Elwood, S. (2022). Glitch epistemologies for computational cities. *Dialogues in Human Geography, 12*, 361–378. https://doi.org/10.1177/20438206221075714

Mattern, S. (2021). *A city is not a computer: Other urban intelligences*. Places Books: Vol. 2. Princeton, NJ: Princeton University Press.

Moriset, B., & Malecki, E. J. (2009). Organization versus space: The paradoxical geographies of the digital economy. *Geography Compass, 3,* 256–274. https://doi.org/10.1111/j.1749-8198.2008.00203.x

National Interoperability Framework Observatory & European Commission. (2023, February 10). *Legal interoperability*. Retrieved from https://joinup.ec.europa.eu/collection/nifo-national-interoperability-framework-observatory/glossary/term/legal-interoperability

Onsrud, H. J. (1995). The role of law in impeding and facilitating the sharing of geographic information. *Sharing Geographic Information*. Retrieved from http://www.spatial.maine.edu/~onsrud/pubs/roleoflaw36.pdf

Onsrud, H. J. (2010). Legal interoperability in support of spatially enabling society. In A. Rajabifard, J. Crompvoets, M. Kalantari, & B. Kok (Eds.), *Spatially enabling society: Research, emerging trends and critical assessment* (pp. 163–171). Leuven, Belgium: Leuven University Press. Retrieved from http://works.bepress.com/harlan_onsrud/1/

Payne, W. (2017). Welcome to the polygon: Contested digital neighborhoods and spatialized segregation on Nextdoor: Computational culture. *Computational Culture, 6*. Retrieved from http://computationalculture.net/welcome-to-the-polygon-contested-digital-neighborhoods-and-spatialized-segregation-on-nextdoor/

Pomfret, K. (2010, June 6). Spatial law and policy: Why location matters: The legal and policy issues associated with location. Retrieved from http://spatiallaw.blogspot.com/2010/06/apologies-for-delay-in-posting-i-have.html

Reichman, J. H., & Samuelson, P. (1997). Intellectual property rights in data? *Vanderbilt Law Review, 51*, 52–166.

Schutzberg, A. (2010, June 8). *ESRI offers clarifications to NextGov article discussing geodata.gov and data.gov*. Retrieved from http://www.directionsmag.com/entry/esri-offers-clarifications-to-nextgov-article-discussing-geodatagov-and-dat/162354

Sparke, M. (2013). *Introducing globalization: Ties, tensions, and uneven integration*. Chichester: Wiley-Blackwell.

Sternstein, A. (2010, May 28). *White House to tie together mapping and data sites*. Retrieved from http://www.nextgov.com/technology-news/2010/05/white-house-to-tie-together-mapping-and-data-sites/46818/

Theobald, D. M. (2001). Understanding topology and shapefiles. *ArcUser Online*, *April-June*. Retrieved from http://www.esri.com/news/arcuser/0401/topo.html

U.S. Census Bureau. (2018). *Economic Census Flyer*. https://www2.census.gov/about/training-workshops/resources/economiccensus-flyer.pdf

U.S. Census Bureau. (2021, November 22). *Purposes and Uses of Economic Census Data*. Census.Gov. https://www.census.gov/programs-surveys/economic-census/guidance/data-uses.html

U.S. Census Bureau. (2023, August 2). *What We Do*. Census.Gov. https://www.census.gov/about/what.html

U.S. Copyright Office. (n.d.). Copyright law: Chapter 1, §105. Subject matter of copyright: United States Government works. Retrieved from https://www.copyright.gov/title17/92chap1.html#105

U.S. Department of the Interior. (2005). *Geospatial one-stop project awards portal contract*. Retrieved from https://www.doi.gov/sites/doi.gov/files/archive/news/archive/05_News_Releases/050131c.htm

U.S. Government. (n.d.). *Learn about copyrighted government works*. Retrieved from https://www.usa.gov/government-works

U.S. Geological Survey (USGS). (2014, October 3). *The National Map.* Retrieved from http://nationalmap.gov/3DEP/neea.html

U.S. Geological Survey (USGS). (2016, March 31). *USGS global visualization viewer: User guide*. Earth Resource Observation and Science Center (EROS). Retrieved from http://glovis.usgs.gov/ImgViewerHelp.shtml#faq13

Wilmott, C. (2016). Small moments in Spatial Big Data: Calculability, authority and interoperability in everyday mobile mapping. *Big Data & Society, 3*(2). https://doi.org/10.1177/2053951716661364

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