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PEER-REVIEWED POLICY ANALYSIS

Big data, information asymmetry, and food supply chain management for resilience

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Abstract

The Biden Administration is reviewing supply chains as part of its response to recent supply chain failures during COVID-19, and anticipated disruptions associated with climate change. This policy analysis discusses supply chain management, that is, the monitoring and continual improvement of materials flow and information flow to better manage risk. We are in an era of proprietary big data and digitized applications to make sense of it. Healthy food systems require policy to address unequal access to food systems data and information that occurs between businesses as well as between private businesses and government. Managing risk to a nation's overall food system is an important government function that includes setting fair market rules and ensuring open information exchange in food supply chains. In this way, our government ensures equitable food and market access as new technologies and disruptions arise. This paper reviews these concepts considering current policy actions of the Biden Administration.

Keywords

Food Supply Chains, Information Asymmetry, Big Data, Regional Food, Policy, Market Competition, Risk, Food Flow, Digitization, National Security

Introduction

The COVID-19 disruptions generated increased public awareness of the importance—and vulnerabilities—of supply chains across all sectors of the economy. In response, the Biden Administration

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released an executive order in February 2021 emphasizing the importance of "resilient, diverse, and secure supply chains" (Biden, 2021a, para. 2) and announcing the Administration's intention to review and restore critical supply chain infrastructure in the interest of economic and national security. Supply chain managers use information on material and information flow within and between companies to optimize efficiency and profit. If our government is to instead encourage duel optimization of resilience and efficiency, policymakers need to create the conditions necessary for resilience.

In response to the Biden Administration directive, the U.S. Department of Agriculture (USDA) solicited public comment on food supply chain resilience from April to June 2021 and received more than 900 comments. The USDA created a supply chain team to work with similar teams in other agencies, such as the Department of Commerce, charged with information and communications technologies, and the Department of Transportation. The USDA team identified eight vulnerabilities and formed four action teams charged with developing a supply chain assessment over the course of a year, culminating in a report due out in February 2022. The White House also convened a supply chain task force, co-chaired by secretaries at the departments of Agriculture, Transportation, and Commerce. This task force is charged with taking immediate action in advance of the assessment, acting as a "situation room" for food and agriculture (Bailey, 2021).

Especially in the food and agricultural sector, COVID-19 has exposed structural weaknesses and vulnerabilities in supply and distribution (Hendrickson, 2020). "Information asymmetry"—in which a few businesses have access to information and use that information to maintain a competitive advantage—is one of those structural weaknesses. Asymmetry is exacerbated in this era of big data, where extremely large data sets are analyzed with algorithms to discover patterns and trends that can inform strategic action. Big data is defined by criteria such as value, where the information is used for making decisions; volume, where very large amounts of data are collected from a variety of sources; and velocity, where data is processed in real time (Chalmeta & Barqueros-Munoz, 2021). These data are collected by both the public and private sector. As computational capacity has increased, companies with capital have invested in both collecting more data and improving algorithms to make sense of them. At the same time, public resources to collect and make sense of these data for the public interest have not kept pace.

Information asymmetry hobbles the ability of governments and other actors to manage systemic risks holistically, further shifts power to capital, and leaves independent businesses especially vulnerable. Asymmetry creates an unhealthy power dynamic within supply chains where independent businesses are dominated by the larger and more vertically integrated operations that have greater ability to garner and manipulate systemwide information to maintain their market dominance. Such an approach to supply chain information created vulnerabilities that led to whole sector meltdowns in 2020 (Pullman & Wu, 2021). Equitable access to information is necessary for governments to set market rules that are more equitable, resilient, and responsive and for entrepreneurial businesses to create novel food supply chains. It also requires a public sector and policy commitment to support information access for independent businesses as a public good.

To serve the public interest in more resilient and equitable food supply chains, our government must have access to the necessary data and models to make sense of supply chains as they are currently configured, as well as a vision for resilience and benchmarks toward realizing that vision. Supply chain managers are responding to the COVID-19 disruption with the help of big data by upgrading, reconfiguring, and accelerating change in supply chains to attain business goals. How will our government respond over the long term to meet public goals?

Supply chain management focuses on three broad areas: materials flow, information flow, and risk mitigation. Managers monitor and facilitate the flow of materials using big data and modeling to identify and monitor vulnerabilities and ultimately to manage risk. They also identify strategic improvements to the supply chain that may improve overall system functioning. Public policymakers need supply chain analysis to make informed

decisions on *targeted public investment in structural improvements* to create resilience and ensure rapid recovery and continuity in national and regional food systems. Such a strategic investment will support competition in markets, but also include an optimum level of system redundancy to avoid increased risk of complete shutdowns in the face of a disturbance or shock. Such resilience is a matter of national interest.

Background

Markets function to exchange. We typically think of the exchange in terms of goods and services, yet an underexamined item of exchange is information. Consider the variety of information exchanged at farmers markets. The USDA's "Know Your Farmer" campaign carried out during the Obama Administration emphasized customer-to-farmer information exchange, an important component of local food networks. Additionally, such direct markets create a means for information exchange between sellers, such as the going rate for goods and services. Termed "price discovery", farmers can readily see the prices for products at other farmers market stalls. Direct markets, while an important market for smaller farmers, do not necessarily provide stable and sufficient income on their own. Bauman and colleagues (2018) document the importance of small wholesale (intermediated) markets if midscale farmers are to make a living farming.

As farmers enter wholesale markets, obtaining and managing information about distribution and supply becomes more challenging and complex. If only some participants can access and manage this complexity, information asymmetry grows (Akerlof, 1970). This creates an imbalance of power and leaves market transactions vulnerable to failure. In extreme cases, what Harold Innes (1950) termed "monopolies of knowledge" take hold, in which political power is maintained by a few via the control of key communication technologies. More recently, Nobel economist Paul Romer, known for his support of technological innovation, raises questions about power and concentration in technology information markets, proposing a tax that increases with the size of the company, among other solutions to the imbalance of power (Kasperkevic, 2021). Nost and Goldstein (2021) observe that digital technologies "are inherently entangled with the governance, politics and materialization *of* the digital" (p. 2).

Information asymmetries proliferate in today's era of big data. Businesses analyze consumer purchasing trends and manipulate wholesale distribution patterns to increase profits. Private companies have financialized and honed methods to scrape data from the internet and aggregate proprietary data from innumerable private-market transactions. The private sector has also developed proprietary algorithmic models and applications to organize public and private data and discover patterns of behavior that can improve profitability for businesses, at least for those that can afford to pay for data and information services. Vertically integrated supply chains have the capital to do this, hence the largest grocery retailers in the country are already using digital business ecosystems to monitor and manage transactions along the supply chain. This food systems transformation is occurring globally, not just in the U.S. (Mooney, 2018).

Moss and colleagues (2021) document the recent rise of digital business ecosystems, such as the information platforms used by Amazon. This novel business organizational structure uses information as the currency of exchange. Data analytics are supported by artificial intelligence and machine learning that drive user engagement. Digital transformation of the food system gives competitive advantage to businesses agile enough to participate (Ciruela-Lorenzo et al., 2020). Amazon's entry into the food sector, first through its acquisition of Whole Foods and now through regional distribution centers known as "dark stores," has spurred other large food retailers to follow suit and invest in distributed ledger systems, also known as blockchain technology. Independent food businesses and their supply chains are at a considerable disadvantage in these wholesale markets dominated by large grocery chains because they are left out of the information flow, have insufficient capital to develop their own proprietary digital business ecosystems, and lack the necessary coordination between strategic partners (Livingstone & Knezevic, 2020; Navickas & Gruzaukas, 2016).

For the grocery industry, distributed ledgers

are a means to share information on product movement through the supply chain between divisions of the parent company and with strategic supply chain partners. Research and development of private-commission blockchains are funded primarily by large corporate businesses such as IBM and Maerk (Jutka, 2020, Krzyzanowski, 2019), so that the systems are secure, stable, and fast (Jutka, 2020). By increasing transparency between all actors in a supply chain, distributed ledgers are already used to improve food safety (Pearson et al., 2019). Blockchain also holds the promise to make supply chains more traceable, transparent, and sustainable by integrating sustainability metrics into the system (Chalmeta & Barqueros-Munoz, 2021; Jutka, 2020). However, there are several issues that need to be resolved, both technological and in the realm of governance at the global scale, if distributed ledgers are to fulfill their promise. These include data and architecture standards, market regulations, privacy and data protection, and scalability (Jutka, 2020; Pearson et al., 2019).

Due to the explosion of computing services and privatized data, as well as diminished funding for government services, the ability of the federal government to monitor and manage the market data necessary to enforce rules has waned at a time when there is a greater demand for information services (Schmitt et al., 2020). Historically, the USDA has collected, analyzed, and applied data to rebalance and shape markets for food to ensure they are fair and competitive, regardless of scale (Baker, 2019; Gilbert, 2015; Tropp, 2018). The agency had proactively collected agricultural statistics since 1862 and implemented long-range plans to upgrade and respond to technology changes in 1957 and 1982 to create what is now known as the National Agricultural Statistics Service (NASS). However, starting in the 1980s, multiple rounds of budget cuts reduced the number of NASS staff precipitously. Market reports were eliminated or were offered yearly or quarterly instead of monthly, sample sizes were reduced, and programs were merged to meet reduced budget targets. Despite the meteoric rise of computation and information services between 1987 and 2007, NASS computation staff numbered 86 in 1987 and only 132 in 2007 (Allen, 2008). Most recently, the USDA's Economic Research Service (ERS) was targeted for downsizing. Established as an original service of USDA to regulate speculators who were manipulating commodity markets, the ERS provides lawmakers with scientific analysis on markets (Young & McMahon, 2020). In 2019, the Trump Administration moved the ERS offices from Washington, D.C., to Kansas City, Missouri. Rather than uproot their lives, nearly two thirds of the ERS staff chose early retirement or resigned their positions. The offices of the USDA's National Institute of Food and Agriculture (NIFA) were also forced to move to Kansas City, resulting in a loss of many employees and capacity, and diminishing NIFA's ability to support researchers nationwide in their efforts to collect and apply pertinent data.

Over its history, the USDA has intervened in many food supply chains to ensure competitive markets. The Federal Milk Marketing Orders are an early example of such an intervention, established in 1937 under the Agricultural Marketing Agreement Act. Price discovery is one function of these orders. Currently, the USDA monitors the price that processors pay for fluid milk and the rates at which they charge wholesale buyers for fluid milk, barrel cheese, "soft products" such as ice cream, and dry milk powder. The USDA then publicly reports a minimum pay price for those products to reduce information asymmetry among farmers, processors, and retailers. The agency collects data for fruit and vegetable marketing orders as well, but as the produce industry has concentrated, the larger companies and their grower associations collect and analyze their own data. The agency also tracks prices and distribution costs of produce sold at 13 multitenant wholesale markets across the country (USDA Agricultural Marketing Service, 2021), although today much of the trade in fruits and vegetables is conducted outside these spot markets through private distribution centers. Trading outside public markets and through privatized supply chains is termed "market by-pass" and this market data is then proprietary.

The USDA's system of price discovery for the dairy industry and terminal markets for fruits and vegetables use but a fraction of the government data collected to monitor and shape the market-

place. Publicly available data through national surveys and censuses such as the U.S. Census also inform public and private policy-making decisions. The Commodity Flow Survey is an important data source for supply chain managers and transportation planners alike. The Commodity Flow Survey, a joint project between the Bureau of the Census, U.S. Department of Commerce, and the Bureau of Transportation Statistics, Research, and Innovative Technology Administration, provides regular snapshots of goods movement across the U.S. by volume. These data and analyses are used by supply chain managers to understand product flow and are routinely supplemented with proprietary data that managers collect or purchase. Initiated in 1993, this survey is conducted just every five years and takes years to release for public use. For example, the 2017 commodity flow data reports were released in February 2021. The Federal Highway Administration and the Bureau of Transportation Statistics then partner to provide the Freight Analysis Framework, which integrates ancillary data, such as that collected by the USDA NASS, to capture goods movement in agriculture, food, and other sectors. The most recent framework uses 2017 data and was released in March 2021. As the computing power to make sense of large data sets has increased, private-sector demand for public data has only added pressure on public agencies to provide it. At the same time, public access to many of the modeling applications to make sense of big data is limited to those able to pay for a use license which can run US$50,000 or more for a modest project.

Supply Chain Management for Food Systems

Supply chain management is a relatively new field, rising to prominence in the 1990s. It stresses the monitoring of material and information flow within and between companies to inform decision-makers to improve systems and reduce risk. For businesses, this means managers can meet the business goals of efficiency and profitability. For governments, this could mean that public servants meet public goals such as equitable access to food and markets, and supply chain resilience during disruptions.

An early example of the use of supply chain management in the food sector was developed in 1992 by a group of grocery industry leaders called the Efficient Consumer Response Working Group. This group pioneered the concept of "continuous replenishment," made possible by improving a flow of information along the supply chain. Grocers forward purchase transaction data to food manufacturers so that manufacturers can respond "just-in-time," reducing costs, especially for storage (Lummus & Vorkurka, 1999). Very large firms such as Walmart may now include such supply chain management functions in-house, while many firms opt to outsource all or part of supply chain management through third party logistics (3PL) providers.

As a general business strategy, supply chain management is a critical element for managing risk and continually improving organizational processes to achieve efficiency and profitability goals. Supply chain management supports businesses in anticipating and responding to disruption, going beyond meeting immediate needs to build on existing relationships and expertise and stimulating collaboration. This management function looks for opportunities to upgrade, reconfigure, and accelerate change. They "figure it out and get it done," as the supply chain manager for New Jersey ports, Anne Strauss-Wieder, summarized (National Academies of Sciences, Engineering and Medicine, Transportation Research Board, 2020).

While our government need not be in the business of managing food supply chains, since businesses serve that function, government must monitor and ensure competitive markets, especially in wholesale markets, if we are to attain food system resilience. At this writing, there is no equivalent to supply chain monitoring and supporting logistics analytics to identify ways that our food movements and markets can become more equitable and resilient, even though food and agriculture are vital to our national security. Proprietary data are expensive to acquire, if available at all, to planners working in the public interest with public goals in mind. Improving access to public and proprietary data has the potential to improve policy development. However, access to data alone is not enough. There is a need for access to models to sort through big

data to find the patterns that tell the story of how food is moving, how information is moving, and to anticipate and manage systemic risks.

This high-level management function is not readily available to small businesses either, including nonprofit organizations, unless they have the ability to pay or can find a company willing to work pro bono. The American Logistics Aid Network (ALAN) is an effort to provide supply chain management services to communities experiencing a disaster. Yet, as a philanthropic organization, it is unable to meet the extent of need, nor does it address the fundamental issue: *structural inequity in market access and information*. Furthermore, researchers working on market and food access in the public interest lack ready access to proprietary data and applications because they lack the means to purchase them. Sometimes, a public researcher will attempt to work with publicly available data and develop their own model to answer questions of importance to public policy.

A case in point is the development of a food flow model at the University of Illinois (Konar et al., 2017; Lin et al., 2014; Lin et al., 2019). The research team developed a model to find patterns in publicly available commodity flow and freight analysis data, showing how volumes of food move around within the U.S. and between counties. This study on food flow highlights why data and modeling applications are important public functions for agriculture and food. The initial work was made possible with a grant from the National Science Foundation, and refinements-in-progress are currently funded by the USDA.

The private sector already has access to volume and value models to do this work and has access to much more transaction data through its supply chain relationships. Apart from work conducted at some government planning departments, analyzing supply management data is wholly privatized at the sector level by third-party logistics firms and in-house departments. Some government transportation planners pay to use software like IMPLAN or TREDIS to analyze transportation investment impacts, as do some applied economists, or barter for information or database services. Yet for the most part, in-house logistics units and third-party logistics providers use these tools to monitor the flow of food and other commodities that make up their supply chains. The cost to use IMPLAN, especially if proprietary data is required, is out of reach for most of the public sector.

These programs themselves are illustrative of the challenges faced in developing long-term strategies to mitigate information asymmetry. IMPLAN began in the early 1970s as a federal information program for the U.S. Forest Service, and was privatized in 1985 (IMPLAN, n.d.). TREDIS was developed with private investment, and it uses IMPLAN for some of its functionality (TREDIS, n.d.). TREDIS is also in partnership with IHS (Information Handling Services) Markit, a private company that has worked in this field since 1967. TREDIS has acquired 120 smaller information services firms since 1997 and serves as an example of the concentration of information services (IHS Markit, n.d.). For considerable additional cost, these companies offer add-ons that connect to privately owned data.

Policy on the Horizon

Managing a nation's food system is an important government function that includes setting fair market rules, ensuring open information exchange, and managing risk in food supply chains. In this way, our government ensures equitable food and market access and improves system resilience. Improving information flow to mitigate information asymmetry is a high-leverage strategy for system transformation since information is used to monitor market access and inform risk-management strategies. Information flow to improve supply chain transparency requires affordable digital tools, access to data, and rules that both protect data and ensure data portability. President Biden's two executive orders (February 2021 on supply chains and July 2021 on competition) indicate that the Administration takes these responsibilities seriously.

Just as private businesses optimize material and information flows within their companies and between trading partners, there is a need for similar work in the public sector to optimize food system resilience. If there had been a federal agency charged with resilience analytics for the food supply network during COVID-19, understanding the

trade-offs between efficiency and resilience may have resulted in policies to support resilience that would have muted the disruption and avoided cascading systems failures (Golan, et al., 2020; Hynes, et al., 2020).

Instead, there was chaos. The emergency food network that sprang into action in response to the disruption from the COVID-19 pandemic was in many ways flying blind. Loose networks of private nonprofit organizations and state and federal agencies made a valiant effort to undergird the national commercial food system as processors shut down, farmers were left with an oversupply, people lost employment, and schools and restaurants closed. ALAN donated services to some organizations in the emergency food network (ALAN, n.d.), but not to the full complement of national, state, and local practitioners, nor to independent small businesses in need of logistical support for routine operations well before the disruptions caused by the pandemic. According to practitioners in the field, the lack of adequate supply chain management and logistics support raised concerns about how their efforts might not only fail to meet need but cause additional disruption.

For example, much of the food donated for hunger relief also required refrigeration. The need for refrigeration made it difficult for many food banks and their food pantry clients to accept the donations. This need was present before COVID-19 and was much more pressing as supply chains were disrupted and the need for food aid increased (J. Bader, personal interview, April 17, 2020; Hege et al., 2021). Yet simply adding refrigeration capacity to charitable food outlets is not a transformational food system change, because it contributes to system lock-in and dependence on charitable food efforts that rely on volunteer labor and philanthropic support. They do not build wealth.

In this instance, government could invest in business-to-business wholesale cold storage for increased access to markets for regional food producers as a systems transformation strategy. Such an approach supports job creation, local food production, entrepreneurial food businesses, and wealth creation. In cities where these facilities already exist, as documented in Toronto during the pandemic (Dale & Sharma, 2021), food supply disruptions were muted for grocery stores. Such an investment in multi-tenant cold storage infrastructure could be a game-changer for the food system by improving logistics (Lengnick et al., 2015, Miller et al., 2016).

Multi-tenant cold warehousing that creates space for small business transactions is common outside the United States. World Union of Wholesale Markets has 217 members in over 40 countries and five continents. Public-private partnerships are the most common governance arrangement, and they share the primary objective of organizing the movement of fresh products to market to reduce waste and realize energy savings by organizing truck movements (Escoffier, n.d.). The French Federation of Wholesale Markets serves 22 markets in France alone and places a high priority on local commerce and regional food production (Rungis, n.d.). These public-private markets reshape market structure to give small and entrepreneurial food businesses access to wholesale markets. Investing in "regional food enterprise centers" is one action currently under consideration at USDA (Bailey, 2021, quote per author's notes).

It is in the public interest to make supply chain management and logistics support readily available to independent food businesses. Food entrepreneurs function at all points of the supply chain and form the backbone of communities, both urban and rural. They respond to changing local needs and conditions, build economic capacity at the community level, tap into innovation to serve those needs, and give our food system accountability and resilience. They generate wealth. However, few businesses at this scale have access to supply chain data and applications or the capacity to manage them, even though they could benefit from this information. Investment in information infrastructure such as internet access and open-source and/or affordable digital tools is needed. Information infrastructure targeted for independent businesses will reduce information asymmetry in supply chains.

Public researchers are currently mapping existing national food networks to identify key systems nodes at the national and regional level for perishable foods; for instance, the ICICLE project, led by The Ohio State University (OSU, n.d.), is moving

forward the Konar Lab's work on food flow mentioned earlier. Markets functioning as primary nodes for food flow, such as Omaha, Chicago, Los Angeles, and Atlanta, need to collaborate with healthy secondary and tertiary nodes in their regions so that food efficiently reaches what USDA terms "Frontier and Remote Areas," as well as underserved urban neighborhoods. This research aims to provide public planners with the maps they need to identify areas lacking in food flow as well as areas that are particularly vulnerable to disruption (Center for Integrated Agricultural Systems, 2020).

A national system of interconnected regional and local networks that improve food and information flow to serve communities within and outside major metropolitan areas will improve market and food access for all. Each region in the U.S. is likely to have a unique relationship between food production and consumption that has been shaped by growing conditions, transportation routes, business relationships, proximity to primary network nodes, and access to capital. Empirical findings on food flow can be used to document COVID-19's impacts across the supply chain, with emphasis on regional-scale contributions to systems resilience (Center for Rural Engagement, 2020).

When the Biden Administration announced its intention to review critical supply chains for national security, supply chain managers were ready with a report on what this effort could look like. Consumer Brands, a consortium of businesses that manufacture shelf-stable products, along with the Council of Supply Chain Managers and academics at Iowa State University, released a report calling for a Federal Office of Supply Chain (Adderton, n.d.). Throughout the report, they called for an integrated system that links government and business to develop policies that meet business and public goals. However, elements critical to a robust and equitable supply structure were minimized. They advocate for policies that address urban freight logistics, but not rural logistics. They highlight national networks, but not regional or local networks. They promote digitization and innovation in technology, process, and service, but not in the context of independent businesses. They mention the importance of protecting data security, privacy, and proprietary data interests, but skirt issues such as access to digital tools, supply chain transparency, and data protection and portability. These missing issues are important for public efforts to fairly serve businesses at multiple scales and types of organization. They require us to address scale, density, equity, and agency in the food system. Otherwise, we risk further widening the digital divide in the food sector (Sheinfeld, 2021) and worsening information asymmetry.

Meanwhile, the National Grocers Association (2021) released a report describing market negotiation asymmetries associated with access to information and called for a check on supply chain concentration. The grocers group contends that the pandemic has further exacerbated market inequality and that their members—independent grocers across the U.S.—are disadvantaged in this hostile market environment. They provided evidence of buyer power and economic discrimination that threaten independent businesses and called for investigations and hearings, oversight, legislation, agency action, and enforcement. Asymmetrical information is at the heart of wholesale buyer power along the supply chain. Supply chain transparency and equitable information access is necessary to rebalance the system.

At the other end of the food supply chain, delegates to the 2021 National Farmers Union convention in March continued their call for antitrust legislation. Market reform is a core issue for this organization representing nearly 200,000 farmers across the U.S. In his address to the delegation, newly appointed Secretary of Agriculture Tom Vilsack reported that his staff were already investigating issues of concentration and antitrust. He committed to "reforming markets so that farmers can farm" (Vilsack, 2021). For such "new, more, better, and fairer" markets to exist, improved public access to information for all participants in the supply chain is mandatory.

Supply Chain Management in the Public Interest

This policy analysis discusses how supply chain management in the public interest—the monitoring of food and information flows and continual systems improvement—can support strategic im-

provements in the food system to reduce risks and cascading failures such as those experienced during COVID-19. Public planners can monitor supply chains to acquire insight into how food is currently moving through the system, how information is flowing, and how governments may anticipate and manage risk to improve food system resilience. Data and information on food movements is necessary for *targeted public investment in structural improvements* to create resilience and ensure rapid recovery and continuity in national and regional food systems. Such strategic investment will support competition in markets, but also include an optimum level of system redundancy to improve equity in the system and reduce risks from disturbance or shocks. The Biden Administration has made it clear that this is a "once-in-a-generation" (Gambino, 2021, para. 1) opportunity to invest in infrastructure, "to rebuild the backbone of America" (para. 2).

A next step in public-oriented supply chain management is to democratize data and models. Reinvestment in public data collection and analysis is necessary so that policy-makers have the information they need to make markets competitive again. Updating market rules so that they better navigate the technological advances of the last 50 years and those on the horizon is another necessary step. New government rules to support competitive markets must be accompanied by monitoring and robust enforcement. Competitive markets are central to food system resilience because they add redundancy to the food system through self-organization. Markets are now shaped by big data analytics, so we need our governments to move to the front, take hold of these new technologies, and shape food markets for the 21st century.

President Biden's July 2021 Executive Order on Promoting Competition in the American Economy is a sign that our government is poised to move forward in the interest of independent small businesses, workers, and consumers with a "whole-of-government" approach. It contains 72 specific actions to be taken by 14 federal agencies in the coming year. The USDA is charged with developing a plan to promote competition, support value-added agriculture and distribution systems, improve price discovery and access to retail markets, develop standards and transparency in the marketplace, and enhance the marketplace for small food-processing businesses. Similar language directs the Department of the Treasury to improve market access for independent beer, wine, and spirits producers (Biden, 2021b). Defining and measuring competitive capacity at the national and regional scales is core to this work (Green, 2021).

For our regional food economies to thrive and add resilience to our food system, we need information infrastructure that reduces information asymmetry in order to improve supply chain transparency, protect data, ensure affordable access to data and digital tools, and require data portability. All businesses in a supply chain need access to the information in that chain, not only those able to pay for it. As President Biden's executive orders remind us, it is a matter of national prosperity and security for everyone.

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